AD-A135049

REPORT OF DEFENSE SCIENCE BOARD TASK FORCE on

TRANSITION OF WEAPONS SYSTEMS from DEVELOPMENT TO PRODUCTION

AUGUST 1983

DTIC ELECTE NOV 29 1983 S D A

OFFICE OF THE UNDER SECRETARY OF DEFENSE
RESEARCH AND ENGINEERING
WASHINGTON, D.C.

DTIC FILE COPY

This document has been approved for public release and sale; its distribution is unlimited.

83 11 29 297

This Document Has Been

CLEARED

For Open Publication

24 August 1983

Directorate for Freedom of Information
and Security Review, OASD(PA)
Department of Defense

REPORT OF DEFENSE SCIENCE BOARD TASK FORCE

on

TRANSITION OF WEAPONS SYSTEMS
from
DEVELOPMENT TO PRODUCTION

August 1983

Office of the Under Secretary of Defense Research & Engineering

Washington, D.C.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NA	2. GOVT ACCESSION NO.: AD-A135049
3. RECIPIENT'S CATALOG NUMBER: NA	
4. TITLE (and Subtitle): Report of Defense Science Board Task Force on Transition of Weapons Systems from Development to Production	5. TYPE OF REPORT & PERIOD COVERED:
6. PERFORMING ORG. REPORT NUMBER: NA	
7. AUTHOR(s): NA	8. CONTRACT OR GRANT NUMBER(s): NA
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Defense Science Board, OUSDRE Room 3D1020, The Pentagon Washington, D.C. 20301	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: NA
11. CONTROLLING OFFICE NAME AND ADDRESS: Same as above	12. REPORT DATE: Aug 1983
	13. NUMBER OF PAGES: 82
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): Same as Above	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION DOWNGRADING SCHEDULE: NA

16. DISTRIBUTION STATEMENT (of this Report)

CLEARED FOR OPEN PUBLICATION BY OASD/PA 24 August 1983

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

NA

18. SUPPLEMENTARY NOTES

NA

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

NA

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

NA

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

DEFENSE SCIENCE
BOARD

27 August 1983

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR RESEARCH
AND ENGINEERING

SUBJECT: DSB Task Force on Transition of Weapon Systems from Development to Production

Enclosed is the final report of the DSB Task Force on the Transition of Weapon Systems from Development to Production. This effort was undertaken to develop recommendations to improve and accelerate the transition of weapons systems into production. The attached report summarizes the results of the various panels formed to review this problem and contains specific recommendations. This report has been reviewed and approved by the Defense Science Board.

Additional reports were prepared by ad hoc working groups established by this Task Force. They represent the results of considerable effort and should prove useful, although they have not been reviewed by the DSB and therefore do not represent official DSB reports. This applies, for example, to the effort entitled "Solving the Risk Equation in Transitioning from Development to Production."

The Task Force chaired by Will Willoughby and supported by the working groups put much effort into the solution of this problem, and hopefully has produced recommendations that will improve the transition process. As Will Willoughby has stated in his transmittal letter "the key to success lies in implementation." As always the DSB stands ready to assist with this task.

Norman R. Augustine
Chairman

DTIC
COPY
INSPECTED

Attachment
Task Force Report

Accession For
CRA&I
TAB
Unannounced
Justification
Distribution/
Availability Codes
Dist Avail and/or
Special
A-1

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C 20360

IN REPLY REFER TO

25 May 1983

Mr. Norman R. Augustine, Chairman
Defense Science Board
Room 3-D-1034, The Pentagon
Washington, DC 20301

Dear Mr. Augustine: NORM

Enclosed is the report of the Defense Science Board Task Force on Transition of Weapon Systems from Development to Production. The study was conducted in response to the Terms of Reference in Under Secretary of Defense for Research and Engineering memorandum of 28 June 1982 (Appendix A to the report).

The effort focused on a concise group of design, test and manufacturing fundamentals, including key facilities and managerial issues, which constitute the essential elements of low risk programs. This effort produced a transition document that covers some of the critical risk areas that have been observed in the process of transitioning from development to production. This guidance information is totally consistent with established DoD policy and is presented in the form of "templates" which address procedures for reducing those risk areas. These templates are intended to be used by DoD and industry in making decisions on individual acquisition programs.

The Task Force is satisfied with the results of its efforts and feels that the objective of this study was successfully accomplished. However, the key to ultimate success lies in implementation of the Transition Document.

Sincerely,

W. J. Willoughby, Jr.
Deputy Chief of Naval Material
(Reliability, Maintainability
and Quality Assurance)

TABLE OF CONTENTS

	Page
TRANSMITTAL MEMORANDA.	iii
EXECUTIVE SUMMARY	ix
1. INTRODUCTION	1
2. DESIGN PANEL RESULTS	5
DISCIPLINES FOR THE DEVELOPMENT CYCLE	5
FIGURES OF MERIT FOR ALLOCATED DESIGN TIME AND COST . . .	7
KEY PREDICTORS/INDICATORS OF POTENTIAL DESIGN AND MANUFACTURING TROUBLE	7
METHODS OF DISPLAYING DESIGN CONFIDENCE	8
DESIGN REVIEW PROCESS	11
3. TEST PANEL RESULTS	13
INTEGRATION OF TESTS.	13
TEST ENVIRONMENTS.	14
RELIABILITY DEVELOPMENT TESTS.	15
RELIABILITY DEMONSTRATION TESTS	16
TEST, ANALYZE AND FIX	16
INITIAL OPERATIONAL TEST AND EVALUATION	17
MILITARY PARTICIPATION IN FSED TESTS	18
FIELD OPERATIONAL PERFORMANCE FEEDBACK DURING THE EARLY MANUFACTURING PROCESS	19
4. PRODUCTION PANEL RESULTS	21
VENDOR IMPACT ON QUALITY, COST AND SCHEDULE	21
WORKMANSHIP DEFECTS - CAUSE AND RELATION	22
ESTABLISHING PART QUALITY CONFIDENCE IN MANUFACTURING. . .	23
RECIPE FOR ENTERING PRODUCTION	24
COOPERATIVE PARTICIPATION BY GOVERNMENT/INDUSTRY	25
DEPOT ORGANIC SUPPORT	26
CORRECTIVE ACTION SYSTEMS	27
MANAGEMENT REPORTING AND TRACKING TECHNIQUES.	28
RISK MANAGEMENT	29
5. FACILITIES AND INVESTMENT PANEL RESULTS	31
INDUSTRIAL MODERNIZATION INCENTIVES.	32
SYSTEM ACQUISITION PROCEDURES.	33
PRODUCTIVITY AND DESIGN/MANUFACTURING INTERACTION	34
DATA BASE TECHNOLOGY.	34
CORPORATE STRATEGIC PLANNING	35
HUMAN RESOURCES	35
POSITION PAPERS	36

TABLE OF CONTENTS (continued)

	Page
6. MANAGEMENT PANEL RESULTS	39
MANAGEMENT PRINCIPLES	40
ADDITIONAL OBSERVATIONS	48
RECOMMENDATIONS	51
APPENDIX A: Terms of Reference	53
APPENDIX B: Task Force Membership	57
APPENDIX C: Panel Membership	59
APPENDIX D: Recommendations for Continued OSD/DSB Action	64

EXECUTIVE SUMMARY

OBJECTIVE

The objective of this report is to provide recommendations that will lower the risk of transitioning weapon systems from design and development into production.

BACKGROUND

The past years have witnessed a rapidly accelerating interest in upgrading the reliability and maintainability of the weapon systems, those already operational and those programmed for ultimate delivery to the services. Major reasons for this increase in interest include the length of the acquisition cycle, the unsatisfactory levels of effectiveness, and budget pressures to reduce the life cycle costs of new weapon systems. Yet, in spite of this interest, tangible improvement in the reliability and maintainability of products reaching the field continues to be an area of concern. And a major cause for this concern has been observed to be the failure to make the proper transition from design and development into production.

The Defense Science Board (DSB) Task Force on Transition of Weapon Systems From Development to Production was established in June 1982 to identify the fundamentals of low risk design and manufacturing processes. These fundamentals were to include not only the technical aspects of the design and manufacturing processes but also some of the key funding and managerial issues.

APPROACH

The DSB Task Force consisted of top level engineering, production and program management personnel from both industry and the government. These individuals all possessed extensive experience with the Department of Defense material acquisition process. The approach involved the formation of five panels to address issues related to design, test, production, facilities and investment, and management, respectively. Each panel was chaired by a Task Force member and each member generally supported more than one panel. Each panel addressed several of the issues stated in the Terms of Reference and submitted its own panel report to the Task Force Chairman. These results were then reviewed and consolidated and are submitted in this report for consideration by the Office of the Secretary of Defense/Defense Science Board.

SUMMARY OF RESULTS

The following paragraphs constitute an overview of the key findings, conclusions, and recommendations of the study effort. The material is divided into the five areas that were addressed by the individual panels. The body of this report provides a comprehensive discussion of the results, and the individual panel reports are attached for reference purposes.

Design Panel

Disciplines for the Development Cycle. Analyses were focused on the need for program requirements to be completely defined, contractor program teams to be properly staffed with qualified personnel, design teams to be furnished with proper tools, and schedules to be realistic. Recommendations in this area underscored the need for DoD services to ensure that RFPs communicate all program requirements, that proposals are reviewed for credibility, that contract documents formalize all requirements, and that care be exercised in selecting the government program manager.

Figures of Merit for Allocated Design Time and Cost. Figures of merit can be developed for front-end loading of funds; for the allocation of budget, manpower and elements of cost; and for timing and interrelating the typical development phase activities. However, further study is required in this area, and the Defense Systems Management College or a qualified consulting firm should be tasked to continue the work of the panel.

Key Predictors/Indicators of Potential Design and Manufacturing Problems. General indicators of design problems were found to include the degree and timing of change in design requirements and the number of design corrections resulting from technical reviews. Indicators of manufacturing problems were observed to include rejection rates and parts supply shortages. Large work force turnovers were found to be one of many indicators applicable to both design and manufacturing. Because of the importance of basic indicators, government programs should require formal implementation of a management system for identification and tracking of critical parameters. The system should be designed to indicate current technical status and to predict problem areas requiring corrective action.

Methods of Displaying Design Confidence. Design confidence is enhanced by requiring design maturity to occur in the development phase, establishing appropriate design margins, and using effective technical performance measurement systems. As a means for enhancing design confidence, DoD documents should promulgate requirements for the use of design margins. Implementation of technical performance measurement systems should also be required by contract as a part of full scale development programs.

Design Review Process. It was recommended that specific requirements be cited in development contracts for design reviews; that the review process be systematized, including the use of detailed checklists; and that government participants should be selected on the basis of experience and expertise. Other observations included the value of considering major assembly tooling in the design review, the use of Computer Aided Design (CAD) technology to support the design review process, and the use of an action item follow up system as a part of the design review process. The panel also recommended a policy document that would require a formal design review plan to be approved by the government program manager.

Test Panel

Integration of Test. An integrated test plan should be developed early in the acquisition process to ensure maximum efficiency in testing.

Test Environments. One specific set of operational environments should be established for the system, and these in turn should be allocated to each end item of equipment. This does not preclude the use of a more severe environment to provide a margin for actual operation or to provide failure data.

Reliability Development Tests. Subsystem selection for reliability development tests and the tailoring of test requirements should be based on the subsystem's contribution to overall system unreliability. Reliability development testing should also be integrated with other development tests to minimize test cost and the impact on program schedules.

Reliability Demonstration Tests. Emphasis should be placed on reliability development and other development testing in lieu of reliability demonstration testing. Dedicated reliability demonstration tests should not be recommended for development programs. In special cases where demonstration is necessary, the demonstration should be tailored to make maximum use of other development and operational test data.

Application of TAAF Philosophy. Specific DoD guidelines should be prepared for defining the application of the test, analyze and fix (TAAF) philosophy during system and subsystem level tests and to provide the methodology for reliability growth tracking using all test results. Guidelines should emphasize the need for a closed loop failure analysis and corrective action program and for rigorous configuration management to control the modification of system elements during the transition period.

Initial Operational Test and Evaluation. It was found that operational test and evaluation conducted in discrete phases during transition from development to production will provide an operational assessment for use by government decision makers at appropriate milestones. Consistent with this finding, DoD Directive 5000.1 and DoD Instructions 5000.2 and 5000.3 should be modified to provide a more reasonable transition-to-production phase bounded by milestones instead of a single point at which development ends and production begins.

Full Scale Engineering Development Tests. DoD guidance regarding test and evalution should encourage contractural agreements between the contractor and the military services for military participation in DT&E during FSED.

Field Operational Performance Feedback During the Early Manufacturing Process. The Panel concluded that on-site engineering analysis will enhance early correction of problems encountered in initial service operation of new systems. Therefore, on-site engineering teams should be provided by the contractor to observe initial operations and to assist in identifying problems and their corrective action.

Production Disciplines Panel

Vendor Impact on Quality, Cost and Schedule. Percentages of subcontracted work on major weapon systems has grown and has reached as much as 80% in some instances. Prime contractors remain responsible for subcontracted work; however, subcontract management plans and systems need improvement. Also, primes need to improve implementation of their subcontract management systems to correct this area of concern.

Workmanship Defects. Workmanship defects during production are caused by management's failure to provide proper tools and resources to the operators. Innovative techniques, as described in the panel report, are a means to cope with poor workmanship and excessive rework.

Part Quality Confidence in Manufacturing. The Qualified Products List (QPL) program, though a valid concept, does not currently assure that parts meet specified quality standards. Receiving inspections are generally more cost effective than source inspections, and contractors should be allowed flexibility in determining and adjusting defect threshold limits in receiving inspection. Contractual leverage for assuring parts quality include competition, quantity buys, buyer testing and feedback. In addition, government program managers should require contractors to identify their choice of parts inspection techniques and include this information in the Production Plan. The government should also take action to revitalize the QPL into an effective program.

Recipe for Entering Production. Government programs should require and fund a contractor Production Plan. Initially, this plan should be prepared no later than the start of engineering development and be continually updated until rate production is achieved. A formal production readiness review should also be jointly conducted before beginning initial production. Additionally, proof-of-design and proof-of-manufacturing models should be authorized and funded.

Cooperative Participation by Government/Industry. Contractors generally need time and flexibility to optimize unit production rates and to solve basic design and production errors without government punitive actions. Therefore, the government should adopt a more constructive attitude regarding early identification and elimination of design and production deficiencies. Government control of the technical data package should also be deferred until the conclusion of the first year's production deliveries or IOC, whichever occurs later.

Depot Organic Support. Contractors should maintain control of the configuration for at least 2-3 years beyond deployment to allow for maturation. During this period, the contractor should be responsible for the total analysis and repair task. A product improvement warranty should be required from the contractor with sufficient incentive/penalty provisions for proper motivation.

Corrective Action Systems (CAS). In defense weapon system contracting procedures, CAS is not generally recognized and funded. The consequence is to delay the "ready-for-production" date with attendant schedule slips and cost increases. The government program manager should require integrated CAS plans as part of the prime and subcontractor production plans. These plans should be an evaluation item for production readiness reviews.

Management Reporting and Tracking. Adequate techniques exist in industry to provide management with the information needed to implement prompt and effective decisions during the transition phase. Effective management tracking and reporting include product quality, workmanship, manpower build-up, build-to-cost objectives, and post delivery performance. DoD publications should describe the effective tools that industry has developed to provide senior management with in-depth program visibility.

Risk Management. Risk management is a significant factor in successfully accomplishing program objectives and delivering a quality product on time and at a reasonable cost. Both industry and government personnel should be aware of the importance of the techniques for risk identification and management.

Facilities and Investment Panel

Industrial Modernization Incentives. Government and industry should cooperate to assure a modernized Defense Industrial Base and mutually share the risks associated with achieving this objective. DoD should continue to support the Industrial Modernization Incentive Program (IMIP) and give this important initiative the widest possible dissemination at all levels within Government and industry.

System Acquisition Procedures. DoD should put strong emphasis on the need for production planning early in the acquisition process and the involvement of manufacturing engineers during the development phase. Industry and the Government should recognize the importance of streamlining proposal requirements through more effective use of Draft RFPs. The application of existing source selection procedures should be improved by emphasizing the need for: more realistic technical and schedule requirements; additional consideration to cost credibility and risk assessment; greater weight on the contractor's past performance and capital investment programs; and de-emphasizing the importance of the lowest proposed cost.

Productivity and Design/Manufacturing Interaction. DoD should encourage and motivate industry to adopt and use totally integrated CAD/CAM systems.

Data Base Technology. The key to a totally integrated CAD/CAM system was found to be the data base technology that could tie together all elements of the design and manufacturing processes including the stand-alone automated modules that may already exist. Enormous costs are involved in developing the necessary data base technology and parallel development efforts within the private sector will be wasteful. Based on this assessment, the panel

identified a national need for a standarized approach to the required data base technology and has recommended that DoD and the National Bureau of Standards jointly provide a focal point for development of data base management system specifications.

Corporate Strategic Planning. DoD should develop a firm, long-term manufacturing strategy for its own facilities using the systems engineering approach. It should then encourage the industrial base to use this model for developing their own long range corporate manufacturing strategies.

Human Resources. DoD and the industrial base managers should work with local education/training institutions to establish appropriate CAD/CAM courses. And employees should be encouraged to attend these courses.

Management Panel

Management Principles. The panel identified five fundamental principles to enhance the total process of development and production. In summary, these are:

- Transition to production must be viewed as an integral part of the Full Scale Development phase.
- A decision to proceed with a program at Milestone II must represent a commitment to produce and to deploy.
- An agreed upon "Acquisition Strategy" must exist at Milestone II.
- The effectiveness of program managers and program management must be improved.
- Greater flexibility in the movement of funds between and among accounts is urgently needed.

Additional Observations. The Panel also presented observations on various management topics, including military specifications, affordability, cost estimating and data requirements.

Recommendations. The Panel submitted four recommendations related to Management Principles and four recommendations pertaining to their Additional Observations.

SECTION 1

INTRODUCTION

OBJECTIVE

The objective of this report is to provide recommendations that will lower the risk of transitioning weapon systems from design and development into production.

BACKGROUND

The success of our defense systems acquisition programs over the past twenty-five years has ranged from exceptionally high to embarrassingly low. Consequently, there is a dramatic and accelerating interest in upgrading the overall effectiveness of weapon systems, both those currently operational and those programmed for ultimate delivery to the services. The length of the acquisition cycle, the unsatisfactory levels of effectiveness, and budget pressures to reduce the life cycle costs have been major reasons underlying this renewed concern for delivering reliable and maintainable weapon systems. However, in spite of this interest and concern, the problems persist.

A major cause of these problems is the failure to make the proper transition from design and development into production. Recent experience has shown that the application of proper disciplines and controls throughout the development phase results in quality products delivered to the operating forces. Therefore, this Task Force was established in June 1982 to examine methods for improving the development process as well as the transition to production.

APPROACH

Terms of Reference.

This Task Force was formed under the auspices of the Defense Science Board to review the process of transitioning from development to production. The formal terms of reference are included in Appendix A and are summarized as follows:

- Examine ways and methods which will more clearly define and accelerate the transition from development into production.
- Direct the inquiry toward both the producing industry and the administering government.
- Recommend the disciplines and controls applicable to design, test and production which will result in the timely delivery of quality products to the operating forces.

In its deliberations the Task Force addressed the 12 areas affecting the transition problem identified in the Terms of Reference as well as several additional issues that were considered relevant to the objectives of the study.

Task Force Membership

The Task Force was composed of top level managers from both industry and government. The membership included engineering, production and program management personnel with extensive experience in the development and production of defense systems and equipment. The team members applied their individual, corporate and government experience and resources in clarifying the issues and developing possible solutions in the form of recommendations for acquisition decision makers. A complete list of the membership is included in Appendix B.

Five Panels Established

The Task Force divided itself into five working panels and assigned specific issues for detailed analysis. These panels covered the following areas: Design, Test, Production, Facilities and Investment, and Management. Each panel was chaired by a Task Force member and each member generally served on more than one panel. Membership on the individual panels also included additional personnel who were selected for their particular expertise in the study area. A complete list of the panel members is provided in Appendix C. Coordination meetings of both the individual panels and the full Task Force were held during the study period. Data and additional contributions to the panel study efforts were provided by other members of industry and the government where needed.

Focus of Study Effort

The initial intention was to focus solely on fundamental principles and guidelines which were consistent with established DoD policy and which could be put into practice or emphasized without the need to change existing policies. However, as the study progressed, the Task Force realized that some of the findings and recommendations would involve policy changes and that others would impact funding. The report clearly indicates where these changes are needed.

Panel Reports

Upon completion of the work performed by each panel, a report was submitted to the Task Force Chairman. Figure 1-1 shows the structure of each report and the relation to the initial issues cited in the Terms of Reference. As the study progressed, additional relevant issues were identified and have been reported on by the panels as indicated by the thirty-seven topic areas listed across the top of the matrix (Figure 1-1). It should also be noted that several topic areas reported on by individual panels have relevance beyond the implied scope of the individual panel. For example, the issue concerning subcontractor and vendor management that was addressed by the Production Disciplines Panel is equally relevant to des gn and test.

TERMS OF REFERENCE STUDY AREAS	TASK FORCE PANEL REPORTS																																							
	DESIGN						TEST								PRODUCTION								FACILITIES & INVESTMENT						MANAGEMENT											
	DISCIPLINES FOR DEVELOPMENT	FIGURES OF MERIT — DESIGN TIME & COST	KEY INDICATORS OF TROUBLE	DESIGN CONFIDENCE	DESIGN REVIEW PROCESS	INTEGRATED TEST PLANS	TEST ENVIRONMENTS	RELIABILITY DEVELOPMENT TESTS	RELIABILITY DEMONSTRATION TESTS	APPLICATION OF TAAF PHILOSOPHY	IOT & E	FSED TESTING — GOVT PARTICIPATION	EARLY PRODUCTION INFO. FEEDBACK	VENDOR IMPACT ON QUALITY, COST & SCHEDULE	WORKMANSHIP DEFECTS — CAUSE & RELATION	PART QUALITY CONFIDENCE IN MFG.	TRANSITION RECIPE	COOPERATIVE PARTICIPATION — GOVT/INDUSTRY	DEPOT ORGANIC SUPPORT	CORRECTIVE ACTION SYSTEM	MANAGEMENT REPORTING & TRACKING	RISK MANAGEMENT	INDUSTRIAL MODERNIZATION INCENTIVES	SYSTEM ACQUISITION PROCEDURES	PRODUCTIVITY & DESIGN/MFG. INTERACTION	DATA BASE TECHNOLOGY	CORPORATE STRATEGIC PLANNING	HUMAN RESOURCES	TRANSITION PHASE VS. PRODUCTION MILESTONE	COMMITMENT TO PRODUCE & DEPLOY	ACQUISITION STRATEGY	PROGRAM MANAGERS & PROGRAM MGMT	FUNDING FLEXIBILITY	MILITARY SPECIFICATIONS	DATA REQUIREMENTS	AFFORDABILITY	COST ESTIMATING
1. FIGURES OF MERIT FOR DESIGN TIME		X																																				
2. KEY INDICATORS OF TROUBLE			X																																			
3. DESIGN CONFIDENCE METHODS				X																																		
4. DESIGN REVIEW PROCESS					X																																	
5. TEST VS. DESIGN CONFIDENCE							X	X	X	X	X	X	X																											
6. MIL-SPEC PROBLEMS							X																															
7. ECONOMICS OF DESIGN/MFG. CONFIDENCE																							X		X	X	X												
8. MANUFACTURING CAPITAL INVESTMENT																							X		X	X	X												
9. INTEGRATED TESTING						X						X																											
10. CAD IN DESIGN REVIEW PROCESS					X																																	
11. PART QUALITY CONFIDENCE																X																						
12. WORKMANSHIP DEFECTS															X																							

Figure 1-1: Panel Report Structure Related to Terms of Reference.

Task Force Report.

Upon completion of the panel reports, the Chairman of the Task Force convened a special working committee to consolidate, coordinate and integrate the findings, conclusions and recommendations of the individual panels and to prepare the Task Force report. This report includes:

- o An Executive Summary that highlights the results as reported by each panel.
- o A digest of the reports submitted by the panels. This digest is to a level of detail sufficient to convey the substance of each conclusion and recommendation put forth by the panels (refer to Sections 2 through 6).
- o A complete copy of each panel report (provided under separate cover), and
- o A separate Transition Document which has been derived from the panel reports. This document is intended to serve as a practical, easy to use guide for identifying and controlling risk on acquisition programs and for improving the process of transitioning from development to production. (Refer to Appendix D).
- o Recommendations for continued OSD/DSB action which are summarized in Appendix E.

SECTION 2

DESIGN PANEL RESULTS

The Design Panel addressed five principal issues. These are:

- o Disciplines for the development cycle,
- o Figures of merit for allocated design time and cost,
- o Key predictors/indicators of potential design and manufacturing trouble,
- o Methods of displaying design confidence, and
- o Design review process.

A digest of the Panel's results is provided in this section. Each principal issue is discussed in terms of background information, conclusions and recommendations. The complete Design Panel Report (attached to this report under separate cover) contains a full discussion of the panel's work and support for their recommendations.

DISCIPLINES FOR THE DEVELOPMENT CYCLE

Issue

Why do we have so much trouble with the design effort, and how can the process be improved?

Background

The successful accomplishment of a development program depends on design requirements that are clearly specified and uniformly understood by the procuring agency and the contractor. The translation of these requirements into a successful design calls for a properly scheduled, adequately funded, and well-managed program that is staffed with an appropriate mix of designers possessing the necessary skills and qualifications. In addition to their basic background, the design staff must be properly oriented to the specific requirements of the program to which they are assigned, and they must be provided with the necessary tools.

Guidelines to aid the design engineer in his task do exist. These guidelines include requirements documents issued by the government as well as contractor-generated direction such as: requirements allocation, design guidelines, parts control policy, training programs, etc. These guidelines are not, however, consistent throughout industry, nor are they uniformly implemented for all programs. Both government and industry agree on

the importance of the design effort and the necessity to apply certain disciplines in this process. It is generally acknowledged that systematic implementation of proven design principles and practices can lead to significant advances in equipment reliability without excessive added cost. The conclusions reached by the Design Panel on this issue emphasize the need for a more disciplined application of the policies, procedures and techniques that are already established and generally known throughout government and industry.

Conclusions

- All quantitative and qualitative system requirements that affect the design must be completely defined, communicated, and agreed to by the government and the contractor. This communication begins with the request for proposal (RFP) and is refined during contract definitization. Producibility should be emphasized early in the design.

- Contractors' development programs must be staffed with a proper mix of technical and management personnel with the necessary level of education and experience. At the initiation of development programs, specific indoctrination on program objectives should be given to all levels to ensure uniform understanding.

- Contractor management is responsible for the design team having all the proper tools, including a well-structured design program, design guidelines, computer facilites, and related data base.

- Schedules for advanced development and FSD programs must be realistic in allowing adequate time for engineering design, analysis, tooling, planning, fabrication, assembly of test articles, and development testing. Checklists should be developed and used to verify accomplishment of these tasks.

- Contractor management is responsible for ensuring that suppliers and subcontractors have complete and definitive design requirements, proper capabilities and tools, and realistic schedules.

Recommendations

The Department of Defense and the Services should assure that new-program RFPs communicate all program requirements. Proposal reviews should specifically assess the thoroughness and credibility of the contractors' responses to ensure that all requirements have been understood and addressed. The government must ensure that the definitized contract formalizes all requirements mutually agreed to by the government and the contractor. In addition, the program manager has a major influence on program success, and as such, his selection must be made with great care.

FIGURES OF MERIT FOR ALLOCATED DESIGN TIME AND COST

Issue

How can we ensure that design time and cost are properly estimated and phased?

Background

The issue suggests the need for better techniques to estimate and allocate design time and cost on development programs. Figures of merit derived from the actual time and cost used on successful programs should facilitate more objective and confident initial planning on future programs. Additionally, more confident planning would help assure adequate and timely funding, and the anticipated results would be fewer cost overruns and schedule slippages.

Conclusions

- o Funding profile - Continuity of funding and front-end loading of funding were found to be significant factors in determining successful programs.
- o Budget ratios - Figures of merit for allocation of budget were successfully developed by the panel to the first level of the WBS. Futher study and analysis will be required to develop more detailed indicators.
- o Schedule - Some meaningful schedule figures of merit were developed for flight vehicles and their major components. Factors, such as system complexity, contractor capabilities and national urgency, peculiar to individual programs were found to affect schedule figures of merit.
- o Hardware cost ratio - Insufficient data was generated to formulate conclusions in this area.

Recommendation

Either the Defense Systems Management College or a recognized, industry-oriented consulting firm should be tasked to (1) review the data and findings of the Design Panel report; (2) plan and conduct appropriate research to expand the figures of merit to the system/subsystem cost level; (3) test the application of these figures of merit on trial projects; (4) revise the Program Manager's Training Course accordingly; (5) revise and maintain these guidelines; (6) periodically distribute updates to these guidelines to Department of Defense and industry program managers; and (7) develop a questionnaire for soliciting opinions and data from key, senior-level management personnel.

KEY PREDICTORS/INDICATORS OF POTENTIAL DESIGN AND MANUFACTURING TROUBLE

Issue

How can we better achieve timely recognition of developing program deficiencies using available indicators?

Background

Early detection of program problems is necessary so that effective corrective action can be taken before the problem grows to a size that significantly impacts or jeoparizes the program. Indicators are, in effect, the sensors that measure progress, indicate current position relative to planned position, and alert the experienced program manager to take timely corrective action. The indicators used and found effective by the companies represented on the panel are shown in Figure 2-1. These indicators are discussed in the Panel report, and highlighted below.

Conclusions

- Design Problem Indicators - Earliest indicators of potential design problems are changes in design requirements or their allocations. Other indicators include difficulties in negotiations with major equipment suppliers responding to procurement specifications or wide variations in suppliers' quoted prices. Means for identifying and correcting design problems can be accomplished through technical performance measurement, test analyze and fix (TAAF) reliability growth tracking, and corrective action systems.

- Manufacturing Problem Indicators - The best indicators of manufacturing problems generally are those normalized to some standard type of baseline rather than absolute numbers. Indicators of such problems may be poor yields detected by manufacturing screens, high rework levels, and parts supply shortages.

- Indicators Applicable to Both Design and Manufacturing - Some indicators include work force composition and stability, and cost and schedule indicators.

Recommendations

Management requirements for new government programs, as defined in the request for proposal and later in contractural documentation, should require the formal implementation of a management system to identify and track critical parameters from both a technical and a program management viewpoint. Proposal evaluators should assess the contractor's responsiveness to this requirement. Some specific indicators that may be useful on individual programs are discussed in the Design Panel Report.

METHODS OF DISPLAYING DESIGN CONFIDENCE

Issue

How can we measure design confidence?

DESIGN TROUBLE INDICATORS	MANUFACTURING TROUBLE INDICATORS
SCHEDULE VARIANCE/MILESTONE SLIPPAGE	SCHEDULE VARIANCE/MILESTONE SLIPPAGE
COST VARIANCE	COST VARIANCE
DESIGN REVIEW FINDINGS	WORK FORCE TURNOVER/ATTRITION
LATE CDRL ITEMS	ALTERNATE METHODS OF FABRICATION
SUPPLIER/SUBCONTRACTOR PERFORMANCE	PARTS SHORTAGES
BROKEN TECHNICAL PERFORMANCE MEASUREMENT THRESHOLD	SCRAP RATES
FAILURE TO MAINTAIN TAAF SLOPE	REWORK RATES
ECP RATE	YIELD RATE OF SCREENS
HAYWIRES PER UNIT	TEST EQUIPMENT LATENESS
CORRECTIVE-ACTION ACTIVITY	ASSEMBLY NONCONFORMANCES
ITEMS IN FAILURE ANALYSIS	ASSEMBLY MAN-HOUR DEVIATIONS FROM LEARNING CURVE
CHANGE TRAFFIC	BENCH-TEST TIME/ANOMALIES
	EIDP VARIABILITY
	ITEMS IN FAILURE ANALYSIS
	CORRECTIVE-ACTION ACTIVITY

FIGURE 2-1: DESIGN AND MANUFACTURING TROUBLE INDICATORS

Background

The development process begins with the translation of design requirements into a conceptual design; it ends with a documented definition of producible hardware. During the evolution of a design, confidence is achieved by progressive evaluation, analysis, review, and test. Techniques used to monitor the design process for identification and correction of problems also build design confidence.

Design requirements are established to ensure the resulting equipment will perform as required at the levels of reliability and maintainability specified. Initially, the design requirements must be properly defined in the contractual specifications for the program. Design margin policies can then be established at the outset of the program and applied consistently.

The challenge to building design confidence during a development program is one of assuring that the significant characteristics of a design have been identified early, that the specified margins have been achieved, and that the design is in fact ready for production. Current government contracts have been inconsistent in the definition of required margins and have therefore not provided a uniform basis for assuring design confidence prior to production. Without this basis, deficiencies often are not discovered until after equipment is in service, at which time the corrective action to recover intended performance is either too late or too costly to be of practical value. The ability to assess design capability during development is an essential part of the determination of design confidence, and this confidence is assured by verifying that specified levels of design margins have been achieved.

Conclusions

- Successful programs force production design maturity to occur during development so that the planned product can be built and fully evaluated before development is over. This approach enables confidence to be established in the design and the resulting product. The use of design margins is also central to achieving design confidence.

- A good way to gain confidence in the design as it progresses from system synthesis through development testing is through the use of an effective technical performance measurement system that enforces self-assessment of the design status against all important requirements and objectives on a continuing basis.

- Development should be authorized with production in mind from the outset in recognition of the fact that continuity is not only beneficial for minimizing cost and schedule variances but necessary to a successful transition from development into production. Initial "pilot" or "low-rate" production concurrent with the later stages of development can be beneficial in building design confidence if appropriately used.

Recommendations

DoD documents should be developed to promulgate the concept of design margins for technical parameters (e.g. margins for structural integrity). Recent military programs have addressed component derating for electrical parameters such as voltage and power dissipation. In the F/A-18 program, the added dimension of "design-to" requirements for reliability, which exceeded the specification requirements, was introduced as a means of providing adequate margins. A military standard or series of standards to formalize these concepts and to provide a reference for future contractual requirements should be developed.

Technical Performance Measurement (TPM) is currently defined in MIL-STD-499. Procuring services should develop requirement guidelines for program sponsors that require the contractual implementation of a TPM system as a part of full scale development programs.

DESIGN REVIEW PROCESS

Issues

Why is the design review process important and what can be done to improve the process?

Background

Any contractor involved in any recent Department of Defense program will immediately acknowledge the importance of well-structured design reviews. Design reviews accomplish two main purposes: (1) they bring to bear additional knowledge to the design process to augment the basic program design and analytical activity, and (2) they provide a formalized means of verifying the satisfactory accomplishment of specified design and analytical tasks as a basis for approval to proceed with the next step in the design process.

Design reviews fall into two general categories: (1) internal reviews in which the contractor conducts a technical review of his own design and (2) external (or formal) design reviews conducted jointly with the government and the contractor. The level and intensity of the design review process must be tailored to each program and must be appropriate to the complexity of the design task, level of development risk, and criticality of the design requirements. Internal reviews are typically scheduled by the contractor to precede the formal design review required by the contract. External reviews with the customer are needed to obtain continuing design approval from government technical specialists.

At least three government documents exist that prescribe the proper conduct of design reviews, but many of the current DoD programs do not invoke these documents as a contractual requirement. Those that do cite the requirement have not always properly implemented the design review process. Where government contracts for defense hardware require the conduct of design reviews, the

main problem appears to have been a lack of specific direction and discipline in the design review requirement. This has resulted in an unstructured review process that has failed to accomplish the purposes of the process. The attitude of the procuring service toward design reviews contributes to this problem by fostering the perception that a design review is a mini program review to be conducted for the purpose of familiarizing people with an overview of hardware design.

Conclusions

- Design reviews should be a contractual requirement in any new hardware or software development program. A design review plan must be developed by the contractor and approved by the government program manager. This plan must define the design review policy, schedule, procedure, and participants. It should provide for both external design reviews and internal design reviews/inspections.

- Design reviews should be systematized by using checklists consistent with design review guidelines established at the beginning of the program. Internal review must verify conformance to the design review guidelines. Customer reviews should address the exceptions.

- Participants in government design reviews should be selected to provide experience and expertise to the review process. "Observers" are not a proper part of a design review. It is important to limit the size of the design review team. Some people interviewed indicated that 10 participants is a workable upper limit. Large designs should be subdivided into workable small reviews.

- The design review process should be expanded to include review of major assembly tooling. The requirement for this activity should be included in the design review plan for new hardware programs.

- The results of computer-aided design and analysis should be used, when possible, to support the design review process. Examples of computer-aided results are the output information generated via computer simulation or modeling of a software system.

- Action items from design reviews must be documented with assignments of responsibility for action and schedules for completion. Status of action items should be addressed at the next scheduled review. The generation and follow-up of action items are crucial to the success of the project.

Recommendations

Both the Air Force and the Army currently have either MIL-STD documents or design review guidelines for use on their programs. The Navy should issue a similar document with contents tailored to its specific needs.

A policy document should be issued requiring a formal design review plan for each major procurement program. This plan should be approved by the government program manager for compliance with policy. Flexibility should be given the program manager to determine the peculiar requirements of his program.

SECTION 3

TEST PANEL RESULTS

The analyses conducted by the Test Panel resulted in the identification of eight issues. These issues deal with:

- o Integrated Testing
- o Test Environments
- o Reliability Development Testing
- o Reliability Demonstration Testing
- o Application of TAAF during Transition
- o Initial Operational Test and Evaluation
- o Military Participation in FSED Tests
- o Field Operational Performance Feedback

Each of these issues is discussed in this section in terms of background, conclusions and recommendations. The relation of these issues to the areas of study identified in the Terms of Reference is shown in Figure 1-1. The full report of the Test Panel is provided as an enclosure to this Task Force Report (under separate cover).

INTEGRATION OF TESTS

Issue

How does integrated test planning of subsystems and systems bear on the transition from development to production? Why is it important, and what can be done to optimize the efficiency of the total test plan?

Background

Adequate testing is essential from the development phase of a contract through initial production in order to assure that the product meets its performance and reliability requirements. Contracts typically call for tests to be performed as part of the developmental process. These tests often do not correlate well with each other, and they may not be sufficient to ensure product integrity. Conversely, testing often occurs in subsystems far in excess of common sense. Many of the test scenarios are developed independent of specific contract requirements, occur in different design groups in the

contractor's facility, and are not necessarily coordinated at the program level. This causes redundant testing and degrades the efficiency of the test process.

Conclusion

An integrated test plan should be developed early in the program to ensure maximum efficiency in testing. This plan should include all subsystem and system testing, minimizing redundant tests and maximizing equipment utilization.

Recommendation

The services should require an integrated test plan to be generated by contractors in concert with the guidelines stated in the conclusion (above).

TEST ENVIRONMENTS

Issues

How do test environments affect the test program, and do they have an effect on the transition from development to production? Can they be optimized to reduce schedule times and reduce costs?

Background

Numerous environmental tests, including vibration, shock, temperature, humidity, and altitude, are run during the developmental phases of a contract. They are run at both subsystem and system levels. The environmental levels are based on the top system level operational requirements. However, these requirements may not be applicable to all levels of the system. In all cases the test requirements established by the contract specification must be met by the contractor.

Conclusion

One specific set of operational environments should be established for the system, and these in turn should be allocated to each end item of equipment.

Recommendation

The contractor should establish subsystem environments in accordance with the following guideline:

> "One specific set of operational environments shall be established for the system, and these in turn shall be allocated to each end item of equipment. These environments shall be the minimum used and shall be tailored to the expected environment for each end item during all environmental tests. This does not preclude the use of a more severe environment to provide a margin for actual operation or to provide failure data."

RELIABILITY DEVELOPMENT TESTS

Issues

How do reliability development tests bear on the transition from development to production? Why are they important? What can be done to optimize the cost of these tests?

Background

Reliability development tests are conducted under controlled conditions using simulated mission environments to determine design and manufacturing weaknesses. The tests emphasize reliability growth rather than a numerical measurement. Many past development contracts have not given proper emphasis to reliability development testing, and test requirements often have been applied arbitrarily to system elements. Both situations lead to difficulties in transition to production.

Conclusions

Reliability development testing should be integrated with other development tests to minimize resource costs (test facilities, test hardware, personnel) and the impact on program schedule.

Selection of subsystems to undergo reliability development tests should be based on the subsystem's impact on the reliability of the overall system.

Subsystem reliability development testing should be terminated when the expected reduction in failure rate becomes small with respect to the subsystem requirements.

Recommendations

MIL-STD-785B should be revised to include the guidelines expressed in the conclusions (above). Specifically, this includes the criteria for the selection of subsystems and the termination of reliability development testing. Additionally, although MIL-STD-785B identifies integrated testing, additional emphasis and flexibility should be added. For example, an integrated laboratory development test plan should be an acceptable alternate to the separate reliability test plans specified in the Standard.

This revision should be initiated with a DoD policy statement to emphasize the point that reliability development (TAAF) tests are primarily contractor tests intended to support the development of a reliable production design.

RELIABILITY DEMONSTRATION TESTS

Issues

How do reliability demonstration tests bear on the transition from development to production? Are they important? Are they cost effective?

Background

Reliability demonstration tests are conducted to determine, with a specified confidence level, whether the MTBF requirements have been achieved. The demonstration tests are normally performed in accordance with MIL-STD-781 and include extended test time under a specific mission profile. If required, they are performed late in the development phase; and concurrent Test, Analyze, and Fix (TAAF) activities are prohibited due to the controlled structure of the demonstration. Unlike reliability development tests, these tests are not designed to provide reliability growth for the transition from development to production.

Conclusion

Emphasis should be placed on reliability development (TAAF) and other development testing in lieu of reliability demonstration testing.

Recommendations

MIL-STD-785B and MIL-STD-781C should be revised to incorporate the guideline identified in the conclusion (above) and delete contradictory guidelines. Specific methodologies or guidelines should be added to MIL-STD-785 to define integrated test and assessment techniques. Both the MIL-STD-785B reference to MIL-STD-781C and the contents of the latter document should be revised to allow innovative test methods, and the integration of reliability assessment with other development and initial operational tests.

Since these revisions may take considerable preparation and coordination time, DoD guidelines should be prepared to revise current contracting and program planning practices and to guide the military standard revisions.

TEST, ANALYZE AND FIX

Issues

Should the test analyze and fix (TAAF) philosophy be continued on all subsystem and system tests and system operation during the transition from development to production?

Background

The TAAF philosophy generally is associated with tests which are used as a development tool for improving the reliability of systems and equipment. Such tests emphasize reliability growth by using an iterative test-redesign-retest process, which identifies corrective action for equipment design and manufacturing processes. Reliability growth measurement and tracking can provide acquisition managers the best possible insight into actual versus planned progress. It is becoming top management's principal tool for assessing program readiness for transition from development to production.

Conclusion

The test, analyze and fix (TAAF) philosophy should be continued on all subsystem and system tests and system operation during the transition from development to production. This philosophy should be coupled with an effective closed loop failure analysis and corrective action system.

Recommendations

Specific DoD guidelines should be prepared to define the application of the TAAF philosophy during system and subsystem level tests and to provide the methodology for reliability growth tracking. Guidelines should emphasize the need for a closed loop failure analysis and corrective action program and for rigorous configuration management to control the modification of system elements during the transition period.

INITIAL OPERATIONAL TEST AND EVALUATION

Issues

During development, how does the government gain confidence that risks are being brought under control, that the schedule is on track, that performance and reliability thresholds are being met, and that system specifications are still appropriate to the operational need and threat?

Background

The government's basic acquisition process is still founded on the "fly before buy" principles of the Fitzhugh Blue Ribbon Panel report of 1970. The basic DoD acquisition process makes use of "milestone" decision points in each program (Milestone I - concept selection and entry into demonstration and validation; Milestone II - commence FSED; and Milestone III - complete FSED and commence production). At each milestone DoD decision-makers review T&E data and make decisions (proceed, cancel, restructure, etc.). The government's goals in structuring programs are to preserve the options of decision-makers at each milestone (i.e., to avoid precommitments) and to ensure that government T&E data (in addition to contractors' T&E data) are available to decision-makers at each milestone.

Conclusion

IOT&E by the Service's independent test agency should be conducted in discrete phases during development and provide data to support the decision making process.

Recommendations

Industry must be made more aware of DoD's basic milestone oriented acquisition policy, as set forth in DoD Directive 5000.1, and of DoD's fundamental T&E policy, as set forth in DoD Instruction 5000.3. And DoD Directive 5000.1 and DoD Instructions 5000.2 and 5000.3 should be modified to speak of a transition-to-production phase, bounded by milestones, rather than a single point at which development ends and production begins.

MILITARY PARTICIPATION IN FSED TESTS

Issues

Does military service participation in the contractor's full-scale engineering development (FSED) phase benefit the transition of a weapon system from development into production? If so, how much participation is optimal? What are the risks involved to the military service and to the contractor?

Background

Development test and evaluation (DT&E) by the military services is normally conducted as dedicated tests in discrete periods during FSED. This requires the contractor to allocate test assets for varying lengths of time, a practice which adversely affects the continuity of the contractor's effort. Heretofore, both the military and the contractors have been reluctant to propose combined contractor-military DT&E in the FSED phase. The military fears loss of their dedicated DT&E phases, and the contractor is hesitant to allow service test personnel, whom they view primarily as evaluators/critics, to use a weapon system that is still early in its development stage.

Conclusions

Military service participation (by the DT&E organization) in contractor FSED increases the efficiency of the testing conducted. Until more data becomes available a tentative goal of 10% is a reasonable target for the amount of test effort performed by the services.

Recommendations

Amend DoD guidance regarding test and evaluation to encourage agreements between the contractor and the military services regarding participation in DT&E during FSED. OT&E should remain independent and dedicated. In addition, action should be taken to widely promulgate among defense contractors the savings in cost and time available through service participation in the contractor FSED testing, as well as the enhanced probability of transitioning into production a system more representative of what the service needs.

FIELD OPERATIONAL PERFORMANCE FEEDBACK DURING THE EARLY MANUFACTURING PROCESS

Issue

During the initial phase of service operation of a new weapon system, on-site engineering teams are often used to assist in the transition to service use and to provide early feedback of field problems. Are these teams an asset in the transition process? If so, what types of problems are identified, and should this practice, currently exercised on an ad hoc basis in some cases, be established as a standard policy?

Background

MIL-STD-785B, "Reliability Program for System and Equipment Development and Production", reflects requirements for establishing a Failure Reporting Analysis and Corrective Action System and a Failure Review Board. These two tasks constitute the key elements of an effective reliability growth program. However, these requirements address implementation at the contractor's facility only and do not include provisions for service use at remote sites.
In view of this situation, a survey was conducted by the panel to inquire into both the use and the value of on-site engineering teams during initial service operation. The survey resulted in eleven responses from major aerospace firms, electronics manufacturers, and DoD services.

Conclusion

Major weapon system contracts should include provisions for an on-site engineering team to observe initial operation, assist in identifying reliability and maintainability problems, provide early feedback, and assist in data collection.

Recommendations

DoD 5000.40 and other appropriate policy documents should be amended to reflect the guideline stated above as a conclusion. Include provisions in MIL-STD-785 for implementing Tasks 104 (Failure Reporting, Analysis, and Corrective Action System) and 105 (Failure Review Board) in the operational environment during the transition to service use.

SECTION 4

PRODUCTION PANEL RESULTS

The Production Panel addressed the following issues:

- o Vendor Impact on Quality, Cost and Schedule
- o Workmanship Defects - Cause and Relation
- o Part Quality Confidence in Manufacturing
- o Transition Recipe
- o Cooperative Participation-Government/Industry
- o Depot Organic Support
- o Corrective Action Systems (CAS)
- o Management Reporting and Tracking Techniques
- o Risk Management

The following discussion provides a digest of the Panel's analysis of each issue and includes background information, conclusions, and recommendations. The complete Production Disciplines Panel Report is forwarded as an enclosure to this report.

VENDOR IMPACT ON QUALITY, COST AND SCHEDULE

Issue

What should be done to favorably affect the vendor's impact on quality, cost and schedule?

Background

The percentage of subcontracted work on major weapon systems has grown, reaching as much as 80% in a few instances. Hence the reliance on subcontractors, and on the skills of prime contractors to manage their subcontractors and suppliers, has increased. An informal poll of ten prime contractors resulted in statements that nearly half their programs were in trouble with schedule or cost because of major problems with subcontractors. Clearly, the effective management of subcontractors needs more emphasis.

Conclusions

- RFPs for prime contracts should require responses from bidders with equitable emphasis on subcontractor management planning versus in-house management.

- The responsibility for managing subcontractors remains with the prime contractor. However, the increased amount of subcontracting may have left some primes with ineffective subcontractor management systems.

- Government source selection criteria should give appropriate weighting to subcontractor management planning; and prime contractors should thoroughly evaluate potential subcontractor capabilities before making their selections.

- The prime should keep subcontractor management plans current.

- Subcontractor status should be reported against management plans during routine prime-customer program reviews. Since subcontractor contact with government managers should be controlled by the prime, the prime has a large responsibility for objective and fair reporting.

- Primes should minimize adversary relationships with subcontractors. Effective communications from primes who genuinely want their subcontractors to be successful is an important factor for success.

Recommendation

Government acquisition planning for weapon systems should incorporate the features listed above under the "conclusions". In addition, government personnel should recognize the potential impact that subcontractors have on the success of major programs and not only evaluate the amount of preplanning given by the prime bidders during the selection process but also ensure the thoroughness of implementation after contract award.

WORKMANSHIP DEFECTS - CAUSE AND RELATION

Issue

How can early identification of defects and related causes result in guidance for action during the development process to eliminate defects in the production phase.

Background

Programs have gone into production only to be plagued with workmanship defects. This causes high rework and scrap rates, and in turn results in missed schedule and cost goals. Management's typical response has been to throw resources at the problem rather than to eliminate the cause of the problem.

Conclusions

- Workmanship defects are caused by problems in the initial system design and/or the design of the associated production processes. Planning and preparation associated with the production process may have inherent faults. These include not providing appropriate tools or equipment to operators and not providing for proper training of the production workers to assure the skills necessary for the job.

- When faced with poor workmanship and excessive rework, successful actions have included communication with workers (such as quality circles), being receptive to change, audits by external consultants, special learning centers for workers, willingness to learn from other companies, and investment in enabling tools and process aids.

- The general principles involved in finding the causes and correcting workmanship defects are well known among behavioral scientists.

Recommendations

Innovative techniques are a means to cope with poor workmanship and excessive rework. A positive contribution can be made by respected officials giving public recognition to individuals and corporations for employing innovative techniques in solving these problems.

ESTABLISHING PART QUALITY CONFIDENCE IN MANUFACTURING

Issues

Four issues were related to improving the confidence in parts furnished by suppliers. These issues dealt with:

- Cost-effectiveness of parts inspection (receiving versus source inspection).

- Impact of defect threshold limits for incoming inspection.

- Effective ingredients for contractual leverage to be applied by parts users.

- Improvements related to joint government-industry action.

Background

If parts suppliers rigorously tested all of their products or if there was effective discipline in the Military Standard parts program (Qualified Products List), then ideally there should be no need for retesting parts prior to use. However, industry experience regarding the quality of supplier parts has been disappointing. The consequence in many cases has been substandard parts. Panel data indicate that component failures are the cause of the highest percentage of problems at module and system level tests. Such parts failures cause interrupted factory flows, rework, workarounds, escapes of marginal equipment to the field, and schedule delays.

Conclusions

- Most contractors prefer heavy emphasis on the elimination of defects early in the manufacturing process.

- Receiving inspection is almost always more cost effective than source inspection. Considerations which may favor source inspection include cost of test equipment, the source inspector's ability to detect out-of-tolerance conditions, and the need for in-process inspection for defects not readily detectable on the assembled product.

- A key ingredient for maintaining part quality is timely corrective action through rapid feedback of screening results to suppliers.

- Contractors should be given the flexibility to determine and adjust their own defect threshold limits in receiving inspection. Depending on the commodity, 100% rescreening in some cases can be cost-effective.

- Contractual leverage for assuring parts quality include competition, quantity buys, "pool" buying with dedicated production lines, letters of intent, buyer testing and feedback, and supplier ratings.

- The Qualified Products List (QPL) program is a valid concept, however, due to lax and incomplete government surveillance, it does not currently assure that supplier parts meet the specified quality standards. In addition, screening requirements should be developed to supplement existing specifications.

Recommendations

- Government program managers should require that the contractor identify in Production Plans the choice of incoming inspection techniques. Inspection plans should document the rationale and trade-offs in determining how each commodity is to be inspected.

- End item customers should be encouraged to control reliability and quality at the end product level and to leave flexibility at the intermediate steps.

- Discussion of defect threshold limits and contractual leverage contained in the Panel Report should be published and disseminated. The government should re-establish the QPL program as an effective program, and the Institute of Environmental Sciences (IES) should complete its current work on a uniform set of rescreening requirements.

RECIPE FOR ENTERING PRODUCTION

Issue

What are the principal ingredients in the recipe for transitioning from development into production?

Background

The Panel observed that there is very little in any formal government policy or contractual requirement which lays the ground-work, or even recognizes the need for taking specific actions during the development phase to assure a smooth and successful transition to production. Contractors, because of bad experience in making the transition, have started to develop and enforce internal requirements to assure that a successful production program results from actions taken early in advanced development and throughout the engineering development phases. While it is always within the contractor's prerogative to take whatever actions are necessary, some are costly and time consuming, and most could be better effected if their value were recognized by the customer and if they were joint contractor-customer actions.

Conclusions

- o The goverment program manager should require and fund the contractor's production plan, prepared initially no later than the start of engineering development and continually updated until rate production is achieved.

- o Development contracts should require and fund a formal design-to-unit production cost program, producibility phase, and a manufacturing involvement plan.

- o A formal production readiness review should be jointly conducted by the customer and the contractor prior to the start of initial production.

- o The government should fund proof-of-design and proof-of-manufacturing models.

Recommendation

Each of the conclusions noted above should be included as specific line items in development and intial production contracts.

COOPERATIVE PARTICIPATION BY GOVERNMENT/INDUSTRY

Issue

How can a climate of cooperative participation be created between representatives of industry and government to affect a smooth transition?

Background

Until rate production has been achieved and at least a year's quantity of hardware has been delivered, contractors need flexibility to optimize the producibility of the design, solve basic design errors and omissions, and optimize the manufacturing process. Current government policies with respect to control of the technical data package, granting of local material review board (MRB) authority, classification of changes, and identification of problems and solutions have had an adverse affect on the contractor's flexibility. Extended cycle times for change approvals can cause schedule

delays and potential retrofits. In addition contractors have a difficult time in convincing customers that "find, analyze and fix" at the earliest stages is to the customer's long term benefit. The identification of problem areas by contractors sometimes leads to a government attitude of punitive reaction and results in adversary relationships.

Conclusions

- o Government control of the technical data package should be deferred until the conclusion of first year's production deliveries or IOC, whichever occurs later.

- o If multiple sourcing of prime production programs is contemplated, it should not occur until rate production has been achieved and the maturity of the technical data package demonstrated.

- o Once the government takes control of the technical data package, the contractor should be granted local MRB authority, and on-site authority should be maintained to determine classification of changes.

- o A more constructive attitude should be adopted by the government on the early identification and elimination of design/production deficiencies. Qualified customer personnel should be assigned on site to assist the contractor in timely "find, analyze, and fix" actions. Schedule delays resulting from such actions should not result in penalties.

Recommendation

Conclusions are consistent with established policy and should be implemented under existing authority as appropriate on individual programs.

DEPOT ORGANIC SUPPORT

Issue

Would the delay of implementing depot organic support help facilitate the trans ion process?

Background

There is considerable evidence that support postures have been measurably improved by early emphasis on planning and integration of all support disciplines into the weapon system acquisition process. However, there is also evidence to suggest that logistic constraints, when imposed too early in the process, have resulted in limiting the rapid and even the ultimate maturation of weapon systems to their full potential. The consequence is higher life cycle costs and lower weapon system capability for the dollar.

The current practice of the earliest possible transition to organic depot (in-house) capability was observed by the Panel to be largely wasteful. An example of an alternate approach to organic support is provided by the way

commercial inertial navigation systems are handled. Under this arrangement contractors have a stake in maintenance costs as well as production costs, and they can act quickly because they have a higher degree of autonomy with regard to changes than with most military programs where logistics concerns cause an early constraint on the ease of making changes. The Panel gathered data from the various Services which futher supports the finding that contractor depot support is more cost effective and responsive than organic support.

Conclusions

- Contractors should maintain control of the configuration at least 2-3 years beyond deployment to allow for maturation. Organic depot operations should be deferred during this period and contractors should be given total analysis and repair responsibility until configuration control is transferred to the customer.

- Contractor technical representatives should be assigned in the field for dynamic feedback of critical performance/problem information and to aid in training and orientation of military personnel at the organizational and intermediate levels.

- A product improvement warranty should be intitiated with contractors. It should provide sufficent incentive/penalty provisions regarding performance and logistic support measurements to ensure full contractor motivation within the early years of field introduction.

Recommendation

The above conclusions should be implemented under existing DoD authority. In many cases, some of the commands are already operating under these guidelines; in the others, it will only require a change of policy within the commands.

CORRECTIVE ACTION SYSTEMS

Issue

What are the essential elements of effective corrective action systems?

Background

Currently, two DoD documents are invoked on most significant development contracts to cover the subject of corrective action systems(CAS). The intent may be paraphrased as follows: "Establish a system which, with suitable data analysis and investigation as to problem cause, is capable of implementing changes in a timely manner. Such changes shall be effective in precluding recurrence of the problem." Since any effective system typically requires considerable participation from virtually all functional organizations, this can represent a considerable challenge. When prime contractors pass these requirements to subcontractors there are additional interface difficulties. In addition, under pressure to close the non-recurring charges, contractor production support budgets are usually insufficient to support the continued

levels of effort for expected CAS activity throughout transition. In present defense weapon system contracting procedures, CAS is not generally recognized as an essential program line item, and its legitimacy is suspect. The consequence of not sustaining an effective CAS throughout transition can be to delay the true "ready-for-production" date, resulting in downstream schedule slips and cost increases.

Conclusions

- Essential technical aspects of an effective CAS include data collection, data analysis, investigation, design fix, effectivity of the fix, effectiveness of the fix, timeliness and management support.

- CAS, properly supported and funded, can be very effective in identifying and resolving problems during the transition from development into production.

- Because of the concept of detailed data transfer between prime and subcontractors, primes sometimes overmanage their subs. This results in documentation burdens, prohibitive costs and interface difficulties. As an alternative, primes should employ more effective management techniques using program reviews.

- Contractor management is not always fully aware that, where corrective action is needed, an earlier identification and correction of the problem will provide a higher return on investment of company assets.

- Funding still represents the life blood of tasks and, unless funding visibility is improved, good intentions will be insufficient to achieve the CAS goal. Separately defined funding for CAS should be evaluated in proposals.

Recommendations

The DoD management should communicate its commitment to CAS through the contracting agencies of the government. The government program manager should require integrated CAS plans as part of the prime and subcontractor production plans. The proposed CAS system should be further evaluated at production readiness reviews.

MANAGEMENT REPORTING AND TRACKING TECHNIQUES

Issue

What techniques should be employed to provide management visibility for prompt and effective decisions with respect to schedule, technical, and financial problems?

Background

Segments of the industrial community have been effective in developing management reporting and tracking techniques which permit responsible program

and senior level management to gain early visibility of potential problem areas. Near real time reporting techniques afford management the opportunity to direct company resources to a timely solution of transition bottlenecks. This assures meeting transition cost, schedule and technical goals.

Conclusions

- o Adequate techniques already exist in industry to provide management with the visibility required to implement prompt and effective decisions during the transition phase. Reporting techniques coupled with periodic management reviews are sufficient to provide early insight into potential problems which could impact the transition from a schedule, technical, or financial point of view. Attentive management should be able to cope with any areas of concern to effect an orderly transition.

- o Effective management tracking and reporting includes product quality, workmanship, component quality, manpower build-up , build to cost objectives, and post-delivery performance. All of these factors are contributors in one form or another to the total acquisition cost.

Recommendations

An appropriate DoD publication should be prepared to describe the effective tools that industry has developed already to provide senior management with in-depth visibility.

RISK MANAGEMENT

Issue

What are the elements of aggressive risk management, and how can they be used effectively in assuring good quality, cost and schedule performance?

Background

Each year industry spends huge sums of money on the quality of the products it produces as well as on programs to achieve optimum cost and schedule performance. The industrial objective is to deliver a quality product in a timely fashion at the least cost. One of the factors in successfully accomplishing this objective is effective risk management. The risks vary considerably from one product to another, but a methodology can be developed for the achievement of this objective at minimal cost.

Conclusions

Three elements of risk were identified as a framework around which an effective risk management program can be structured:

1. Sensitivity to risk. The degree to which risk awareness is experienced determines an organization's ability to "feel the risk". The organization must be willing to accept the fact that the best intentions do not always work out and that the best technique to cope with the future is to assess the probability of difficulty and plan for problems.

2. Identification of the risks. Experience is the cornerstone of efforts to identify risks. Reviewing prior knowledge and early establishment of thorough test programs very often will reveal areas of concern to the organization. Candidates for designation as a risk item include any item which potentially could jeopardize schedule or cost constraints, items which cannot be tested or inspected, sole source items or items with an inconsistent test/quality history. In addition, a high level of change activity to meet performance requirements and excessive procurement lead times would also flag trouble areas.

3. Dealing with the risks. To minimize the effect of identified risks, they should first be prioritized with respect to criticality. Organizational decision making can also be upgraded by making sure it becomes more institutionalized and less haphazard. Continuity of program personnel should also be maintained during transition in order to benefit from past experience and to maintain consistency.

Recommendations

Industry and government personnel involved in the management of weapon systems programs should be made aware of the importance of risk identification and management. The techniques indicated herein and available from other sources should be used as appropriate for the program to avoid risk-related problems.

SECTION 5

FACILITIES AND INVESTMENT PANEL RESULTS

The assignment given to the Facilities and Investment Panel was to focus on tasks 7 and 8 in the Terms of Reference, namely:

- Economics of design confidence and of manufacturing, and
- Minimum requirements for manufacturing capital investments.

While the first task specifically involved a financial analysis of the benefits of Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) systems, both tasks involved the overriding issue of capital investment - its formulation, benefits and inhibitors. The Panel quickly reached unanimity that the focus of its attention should be directed towards capital investment as well as the "DoD business environment".

However, recognizing the significant productivity improvement benefits to be derived from CAD/CAM, this area was selected for further critical review by a subcommittee established under the leadership of Mr. Frederick J. Michel, Director for Manufacturing Technology, HQ US Army DARCOM. The members of this subcommittee were drawn from the CAD/CAM user community, the systems community, the financial community, the industrial publications community, academia, leading experts in the field and appropriate government agencies. Their names appear in Section III of the Panel Report.

The Facilities and Investment Report reflects the intermingling of both cost and technical considerations. In keeping with the overall spirit of the DSB Task Force directives, attempts were made to provide guidelines to be used for policy formulation by the heads of each service of the Department of Defense as well as guidance that could be flowed down to acquisition managers. In some instances guidelines were not practical, but the issue was considered of such significance to the Panel's goals and objectives that a position paper was prepared. These position papers are identified in the final paragraph of this section and included in the enclosed Panel report (under separate cover).

The results from the work of the Panel are presented in six major areas:

- Industrial modernization incentives
- System acquisition procedures
- Producitivity and design/manufacturing interaction
- Data base technology

- o Corporate strategic planning
- o Human resources

The following discussion provides a digest of the Panel's assessment of the problem in each area and recommendations for corrective action as well as guidelines for use in system acquisition decision-making. The detailed findings and supporting rationale are contained in the Panel Report.

INDUSTRIAL MODERNIZATION INCENTIVES

Discussion of Problem

Capital Investment to modernize the Defense Industrial Base in the United States is inadequate to maintain a strong defense posture and a world leadership position. Other industrialized nations continue to modernize at a faster rate and, in some instances, surpass the United States in terms of manufacturing productivity. Modernization means lower cost, which relates directly to lower profit potential. More lucrative commerical investment opportunities have lured capital investment away from the Defense Industrial Base.

A particularly good example of the application of a modernization program is reflected in the business arrangement between the USAF and Westinghouse Electric Corporation (WEC). This is a continuing agreement to share savings for approved capital investments that modernize production and result in lower prices to the government. The business deal provides a mechanism whereby WEC can propose capital investments to the USAF to be incentivized through production contracts.

The way this happens is through an unprecedented business arrangement known as "GET PRICE" (Productivity Realized through Incentivizing Contractor Efficiency). This unique initiative by the Air Force's Electronic Systems Division recognizes that contractor operations are process rather than product oriented and resolves the long standing problem of motivating capital investment and modernization. Although centrally managed, the modernization effort is executed through individual program offices which get immediate benefits through system price reduction. Through shared savings, incentives are provided for modernization. With multi-program and possible multi-service applications, this creative arrangement also enhances Government/industry mutual trust and cooperation. The "GET PRICE" concept is further explained in the briefing provided in Appendix B to the Panel Report.

Recommendations

The government and industry should cooperate to mutually share associated risks in order to assure a modernized Defense Industrial Base. Also the Department of Defense should continue to support the Industrial Modernization

Incentives Program (IMIP) and emphasize the importance of this initiative by giving it the widest possible dissemination at all levels of the government and industry.

SYSTEM ACQUISITION PROCEDURES

Discussion of Problem

Emphasis does not always shift from development to production as the acquisition concept indicates. Government and industry production management personnel, working in a design engineering and development oriented community, have often been unable to effect procedures to assure the adequate consideration of producibility as an integral part of the design process. Production risk is inadequately assessed and orderly planning of timely resolution is difficult. Program management's preoccupation with system performance, initial operational capability schedules, and development cost has also been reflected in minimal proofing programs for production processes and tooling because these requirements compete for the development dollar. Similar considerations, aggravated by the drive for cost reduction, have prevented the incorporation of essential requirements for production tasks in contractual instruments.

Extensive and at times unnecessary proposal requirements continue to pervade government procurement documentation, adding to overall cost and detracting from the data most necessary for making decisions.

The source selection process has, at times, encouraged program cost growth due to lack of cost realism, inaccurate assessment of risk or inadequate assessment of the given cost data.

Recommendations

DoD should put special emphasis on the need for involving manufacturing engineers earlier in the design process both for new and on-going programs. And further, DoD should provide a strong emphasis in its CAD efforts to include the manufacturing function as part of an integrated CAD system. All acquisition managers should include production planning as a specific requirement in system development contracts. When funding cuts occur, acquisition managers should be advised to give production planning equal priority with other considerations.

Both industry and the government recognize the importance of streamlining proposal requirements through more effective use of the Draft Request for Proposal (DRFP). When appropriate, government and industry managers should conduct face-to-face reviews of planned program requirements and cost drivers before or during the DRFP stage. Government should use this technique more frequently and industry should seriously consider and recommend needed RFP changes without fear of being considered non-responsive. Government program managers should heavily weigh industry recommendations for improving

productivity and manufacturing producibility. They should give these considerations equal priority with system performance and operational schedules.

DoD should improve the application of existing source selection procedures by emphasizing the need for:

- o More realistic technical and schedule requirements in the RFP.
- o Additional consideration to cost credibility and risk assessment.
- o Greater weight on the contractor's past performance and capital investment programs.
- o Re-emphasizing the importance of the government's most probable cost number in the evaluation process and de-emphasizing the importance of the lowest proposed cost.

PRODUCTIVITY AND DESIGN/MANUFACTURING INTERACTION

Discussion of Problem

In addition to the classic problem of lack of interaction between design and manufacturing, there exists a declining rate of productivity improvement. CAD/CAM is a totally integrated manufacturing system composed of a series of individual modules. These can be operated under a common data base. When operating as stand-alone modules, productivity improvements of 20% or better have been experienced. A totally integrated CAD/CAM system can provide even greater productivity improvements in the industrial base, as well as a basis for overcoming the classic problem of lack of design/manufacturing interaction.

Recommendation

DoD should provide the necessary encouragement and motivation to industrial base plant managers to adopt and use totally integrated CAD/CAM systems.

DATA BASE TECHNOLOGY

Discussion of Problem

The key to a totally integrated CAD/CAM system is a data base management system that ties all elements of the plant and the stand-alone modules together. Many modules already exist, except in the area of geometric modeling. Data base technology is the shortfall. There is a national need for the development of data base technology. Special consideration should be given to, and emphasis placed on, the development of geometric modeling and the integration of the geometric and hierachical data bases.

Recommendation

DoD and the National Bureau of Standards (NBS) should jointly provide a focal point for the development of specifications for a data base management system with DoD providing the seed money for this effort. The development of data base architecture, communications protocols and reliability, data base standards, and software languages should be addressed in two efforts: first, the development of the specifications for a data base management system; and second, the development of the data base management system itself.

CORPORATE STRATEGIC PLANNING

Discussion of Problem

Most corporate strategic planning in the U.S. is financial or marketing oriented. Few, if any, corporations have strategic plans for manufacturing. Consequently, in transitioning material from design to manufacturing, opportunities for achieving substantially lower manufacturing costs are not realized. The success of the Japanese at implementing manufacturing technology is due, in large part, to their philosophy of planning for the long haul. Their plans are modularized and then prioritized on the basis of an estimated Return on Investment (ROI). Also, a well communicated national policy is the basis for the corporate strategy of manufacturing.

Recommendation

DoD should develop a firm, long-term manufacturing strategy for its own facilities using the systems engineering approach. It should then encourage the industrial base to use this model for developing their own long range corporate manufacturing strategies.

HUMAN RESOURCES

Discussion of Problem

Management must understand that the application of CAD/CAM will create the need for new job skills and will eliminate many current jobs. Each function performed in design and manufacturing organizations will be impacted. There is a need for formal training and re-training programs to create a work force in the U.S. that is responsive to current and future technology needs. The lack of trained personnel is a major constraint to implementing technology.

Recommendation

DoD and the industrial base managers should work with local education and training institutions to establish appropriate CAD/CAM courses. Employees should be encouraged to attend these courses. Encouragement should be provided by including in performance reviews, a measure of participation in educational opportunties.

POSITION PAPERS

The Facilities and Investment Panel addressed ten additional issues that required specific changes in established policies or congressional legislation.

A position paper was prepared for each issue and is included in the Panel report. A synopsis of these recommended changes is provided here.

Recovery of Interest Expense as a Cost

CAS 414 recognizes that when a contractor invests in facilities or equipment to perform a government contract, the imputed cost of the interest on such investment is in fact a legitimate cost of performance which could be recovered. In the implementation of CAS 414 by DPC 76-3, DoD has negated the intent of CAS 414.

In order to implement CAS 414 as intended, the imputed cost of capital should be recognized for what it is, an allowable cost, and such costs should be included in the cost base for the computation of contract profit.

Recovery of CAD/CAM Expense (CAS 402 and 418)

The purpose of CAS 402 "Consistency in Allocating Costs Incurred for the Same Purpose" is to preclude the double counting of costs. The purpose of CAS 418 "Allocation of Direct and Indirect Cost" is to distinguish between direct and indirect cost and to assure that such costs are consistently classified. CAD/CAM systems development and operation costs should be classified as indirect costs and allocated to higher and broader levels of the organization. Such allocation could be at a total Engineering or Production level for example, or even at an Engineering/Production Operations level.

DoD directives should be issued, directing DCAA and DCAS to broaden their interpretations to allow CAD/CAM costs to be classifed as indirect and allocated on as broad a basis as appropriate while still assuring current period cost assignment and allocation to the organizations utilizing the CAD/CAM system and receiving benefits from it.

Independent Research and Development IR&D

Present DoD policies do not sufficiently stimulate the development of new manufacturing technology and productivity improvements for plant operations.

IR&D/B&P ceilings should be increased so that ceilings are within a more realistic correlation to actual expenditures, up to a limit based on historic actual IR&D/B&P expenditures of the contractor as a percentage of sales for the previous five years.

Multiyear Procurement (MYP)

Multiyear Procurement (MYP) will allow for considerable cost reduction opportunities in programs if the right kind of funding policies and support are provided. Multiyear programs need funding to support economic order quantities (EOQ) and efficient production rates. Funding policies in DoD should, as a matter of course and without need for special approvals, allow unfunded cancellation ceilings to include both recurring and non-recurring costs.

Competition

Increased competition has long been recognized as an effective means of reducing program cost and improving productivity. The present DoD/industry business environment does not promote effective competition.

Facilities Capital Employed

There is an underabsorption of contractors' facilities capital employed in performance of Department of Defense contracts. The only change needed is a revision to DoD policy presently stated in DAR 3-808.7 to allow Cost of Facilities Capital Employed for Services as well as Research and Development contract efforts, or to require allocation of Facilities Capital Employed on a basis that includes manufacturing activities only, excluding both Services and Research and Development direct charge amounts from the allocation base.

Foreign Military Sales

More efficient use of FMS dollars could provide enhanced capital formulation and additional incentive for capital expenditures for modernization. DoD should consider selective changes to policy so that all the restrictive requirements of DAR, which were legislated and/or developed for use on appropriated funded contracts, are not made applicable to the non-appropriated funded FMS contracts.

Technology Transfer

Government sponsored manufacturing technology can greatly enhance contractor productivity if effective technology transfer is employed. The need for technology transfer has been discussed for years, but we have not done a very good job of communicating DoD funded manufacturing technology programs much less transferring the results among DoD contractors. In addition, we have to understand that one of the basic advantages of technology transfer is improved productivity by reducing planning and duplication of effort.

Manufacturing Research

Research in manufacturing technology is just recently being recognized with funding as a viable means for improving our defense posture. This area needs continued and increased support. To support this expanding need, the DoD should director or encourage the inclusion and expansion of manufacturing research (RDT&E) funding as an intregral part of the MANTECH Program.

Productivity Payback

DoD should adopt policies and procedures to enable a commitment to be made in the first production contract that productivity gains developed and implemented during performance of the contract would be shared in follow-on production contracts. To be an effective motivator, the contractor's share must be significant and go beyond what is available under DAR 3-808.8(a).

SECTION 6

MANAGEMENT PANEL RESULTS

The Management Panel focused their attention in five major areas. Several of these areas were examined by other panels from a predominantly technical viewpoint and are discussed in previous sections of this report. However, a management perspective was considered important to fully address all aspects of the issues involved. The five areas are:

- o Military Specification Problems
- o Integration of Design and Manufacturing
- o Technical Data Management
- o Entry into Production
- o Program Manager and Program Management

At the outset, the Panel members received various briefings pertaining to the above issues and related the substance of these briefings, in a qualitative sense with their own extensive experience in their respective areas of expertise. A preliminary set of conclusions and recommendations was then drafted which were generally directed toward policy and/or procedural changes needed to improve the management of the development to production transition. Since all Task Force Panels were requested to concentrate on actions which could be implemented with little, if any, modification to existing OSD policy, the Management Panel re-evaluated its initial results. Whereas compliance with this request was easier to accomplish for those panels reviewing the more technically oriented issues, the Management Panel, even with a disciplined attempt to restrict its focus, found that their continuing discussions led them back to five key "principles" with four major recommendations. The Panel also made several "observations" which resulted in four additional recommendations. These recommendations were considered to have high payoff potential, although requiring some change in OSD and/or Congressional policy.

Proceeding with this approach, the panel found that several of the emerging principles, observations and recommendations overlapped more than one of the five major areas, which were described previously as the initial assignment of the Management Panel. Consequently, the Management Panel Report as well as this section of the Task Force Report is structured not around the five initial task areas, but around the five key principles and several observations which the Management Panel members agreed were important. At the end of this section are the recommendations that resulted from the panel's deliberation.

MANAGEMENT PRINCIPLES

Principle #1: "Transition Phase" Versus Production Milestone

All elements of government and industry involved in acquisition must understand that "Transition to Production" is an integral part of the Full Scale Development phase. The Design to Production transition is a process and not a fixed event, beginning not later than Milestone II.

Background. This principle reflects the Panel's view that preparing for production has not received the necessary emphasis in the DoD approach to structuring acquisition programs. The early phases of the program (both pre- and post-Milestone II) almost totally concentrate on demonstrating whether system performance can be met within certain economic and reliability criteria. The question of whether the design can be produced while retaining the system performance is usually not answered until late in development.

In large part, DoD policies and practices over the last 10 to 12 years have caused the transition problem. The very existence of a "Milestone" for approval of production implies a point in time where production actions are initiated.

In 1969-1970, when the Fitzhugh Blue Ribbon Panel was charting a course away from McNamara's total package procurement, and when "fly before buy" was coined to describe the new philosophy, the typical program structure of an RDT&E/ acquisition program was as shown in Figure 6-1.

This simple graphic - repeated countless times in documents, briefings, journals, etc. - had a powerful impact. It created in people's minds the idea that there is an instant in time in each program prior to which all effort is RDT&E, and after which only production activity takes place. Unfortunately, this misconception resulted in many ill-advised rules. "Production funds cannot be expended before Milestone III." "RDT&E funds will not be authorized after Milestone III." "Test hardware must be procured with RDT&E funds." "Test hardware must be production-representative." "Production lines will be established using procurement funds." Such is the power of a simple concept, never clearly refuted, that even today, more than a decade later, its legacy ties us in knots as we attempt to transition to production.

In addition, three other factors were identified by the Panel that have tended to deter efforts leading to production. These were:

- a policy which clearly discouraged any concurrency
- a strong set of advocates for completion of expanded testing before granting approval to produce, and
- for a period of time, defense guidance which encouraged starting more development programs than could be carried through to production. The catch phrase was, "R&D for the shelf."

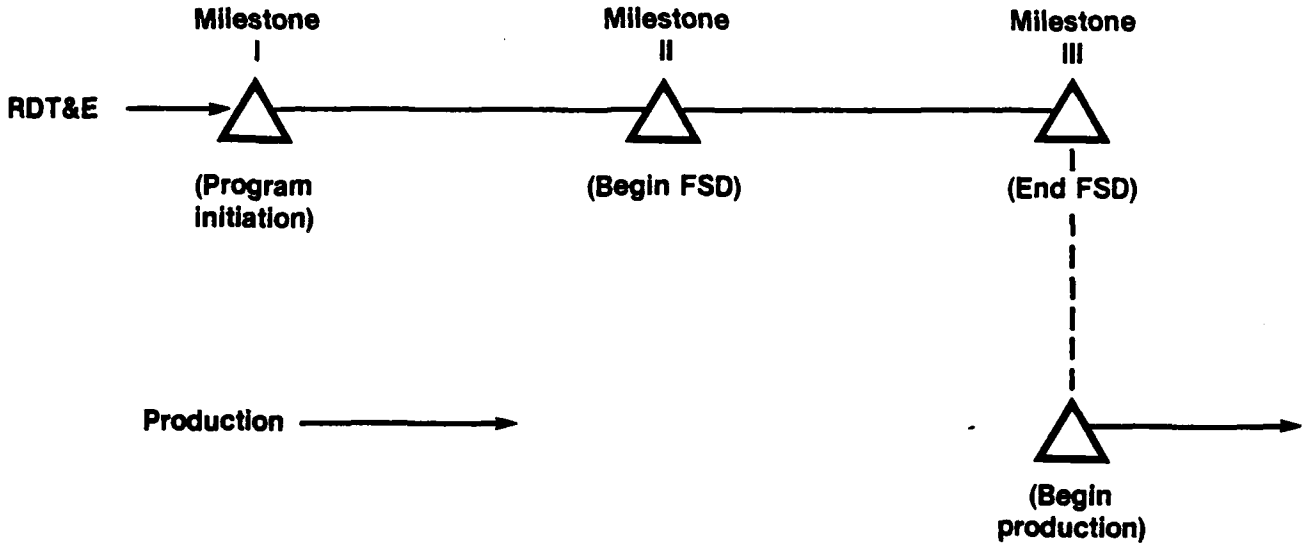


FIGURE 6-1: TYPICAL PROGRAM STRUCTURE -- 1969-1970

The result of these policies and practices was a set of funding rules which made it very difficult to apply resources to producibility, manufacturing planning, tooling and test equipment and other actions leading to production. The standard question was, "How can you request procurement funds when you are not through development?"

Conclusions. The lack of emphasis on getting ready for production is caused in part by the perceptions created by the "Milestone" approach. In addition, current restrictions on the application of funds have made the problem difficult to solve. Programs which had an integrated approach to development and production generally had successful production programs.

Principle #2: Commitment to Produce and to Deploy

Milestone II is the commitment to produce and deploy. All organizational elements of the DoD (and particularly the budget allocators) must be instructed to program, budget and release funds to support the process leading to production. At Milestone II all necessary funds - RDT&E, Production, Military Construction, etc., must be programmed to support the total effort. Actual fund releases for other than RDT&E will be event related (such as test events).

Background. This principle is closely related to Principle #1 dealing with the recognition of transition to production as an integral part of development. The significance and implications of the decision to start full scale development have varied through several versions of DoDD 5000.1. Early versions had a strong emphasis on a sequential approach with little overlap. Budgeting and programming activities were (and still are) structured to minimize procurement investment during the Full Scale Engineering Development phase. Milestone III became a formidable barrier, in part, because there was not a clear commitment to produce the developed item at the time FSED was initiated.

A commitment to produce and to deploy was found to be a necesary and fundamental step in the process of integrating production activities with the design process. On this point, a 1977 DSB Task Force studied the factors contributing to the lengthening of the acquisition cycle. Among their recommendations was one to revise 5000.1 to --

> "Explicitly state that approval for Full Scale Development includes the intent to deploy."

There were other recommendations for revisions to 5000.1. An OSD Task Force was established to rewrite the directive, and a revision was published in March 1980. It stated that the Milestone II decision also means the Secretary of Defense intends to deploy the system. However, This policy statement was short-lived. A recent revision (March 1982) does not include the statement. Without a clear policy, the funds necessary for critical production activities will not be provided, and the current perception that production activities do not start until Milestone III will continue. It must be emphasized that

Milestone III is not the decision to produce and deploy. Milestone III is a program event which provides the opportunity to re-affirm the Milestone II decision.

The current version of this directive, which reflects the Acquisition Improvement Initiatives, made another change which the Panel viewed with some concern because it runs counter to their recommended principles. In the judgment of the panel, the start of full scale development is the major decision in a program. It is a commitment to develop, produce, and deploy the system.

The March 1982 version of DoDD 5000.1 appears to have a "floating" Milestone II, which could take place some time after a Service initiates full scale development. What is the Secretary of Defense's decision point for program go-ahead? We can visualize full scale development contracts with no Secretary of Defense program approval. With a program in this indefinite status, it seems unlikely that a Service would make the investments for producibility. Full scale development approval and program go-ahead should be synonymous.

If Milestone II is a commitment to produce and deploy - assuming development is successful - then funding for production activities must be made available at appropriate times during the development. "Appropriate" is not easy to define, but data developed supports a conclusion that preparing for production should start early in FSED.

There are at least two principal accounts that fund production preparation efforts. The OSD Comptroller's Manual draws a distinction between "Items approved for procurement" and "Items not approved for procurement." In the first case, tooling and test equipment common to both the development and procurement phases are to be financed by procurement appropriations. In the second case, tooling and preliminary production facilities required to provide realistic development hardware are financed by RDT&E - even though they may later be used for production. Clearly, the key is whether a decision has been made for procurement. Without such a decision, the often beleagured RDT&E account must finance production start up activities. In addition the RDT&E account supports producibility studies, design to cost studies, tooling and test equipment planning, manufacturing planning, etc.

Informal discussions with both government and contractor program managers were held. Their view was that RDT&E funds programmed for these purposes were always inadequate and that, even when programmed, they were "raided" when development problems occurred. The Management Panel is of the strong opinion that funds must be programmed, budgeted and allocated during the development process to achieve any reasonable chance of a successful transition to production. The funds can come from either an enhanced RDT&E budget or from procurement funds. Supporting funds such as MILCON should also be programmed. The pace of production preparation activities will be set by progress in the development program.

Conclusions

The current version of DoDD 5000.1 does not explicitly state that Milestone II is a commitment to produce and to deploy and the "floating" Milestone II leaves programs in an indefinite status. Full scale development approval and program go-ahead should be synonymous.

Principle #3: Acquisition Strategy

An agreed upon "Acquisition Strategy" must exist at Milestone II. The Acquisition Strategy identifies the major decisions which affect the conduct and cost of the program. It becomes the "contract" between the program manager, his seniors, and the interfacing and supporting organizations. (It also is the "contract" between the Service and OSD.) Examples of subjects addressed are:

- Type of contracting for both development and production.
- Extent of competition.
- System integration responsibility.
- Use of multi-year contracts.
- Technical data package.
- Test criteria.
- Required resources by account and by year.
- Requirements imposed by supporting organizations.

Changes imposed on the program manager can then result in "contract" changes, with appropriate cost, schedule and performance relief. To support the strategy, a complete Program Plan must exist which defines who will do what to execute the program.

Background. An acquisiton strategy must exist at Miletone II (at the start of full scale development). DoDD 5000.1 states:

> "Develop an acquisition strategy at the inception of each major acquisition that sets forth the objectives, resources, management assumptions, extent of competition, proposed contract types, and program structure...."

The most recent draft of DoDI 5000.2 (October 1982) requires that, at Milestone II, a section of the Decision Coordinating Paper (DCP) address the Acquisition Strategy. Further, when an Integrated Program Summary (IPS) is required, the strategy is a sub-element of a procurement section. In both cases, it appears that the importance of a well-defined, agreed-upon strategy is not adequately stressed.

The Panel concluded that the acquisition strategy should be, in effect, the agreement or contract between the Program Manager, his service seniors, and interfacing and supporting organizations. A condensed version should be the agreement between the service and OSD. This version would address the major management issues which have substantial impact on the conduct, cost and funding profile of the program. These generally would be of such criticality that they would not be delegated to the Program Manager. He, of course, should be heavily involved in the development of recommendations.

It is very important to define those decisions which are considered the responsibility of top management (either service or OSD). In general, they would be issues which have major impact on funding and schedule. Examples of such issues are:

- Extent of competition of both development and production
- Management of system integration
- Production rates and related facilities
- Extent of test program
- Need for re-procurement - i.e., extent and content of Technical Data Package
- Type of contracting by program phase, including multi-year considerations
- Degree of pre-planned product improvement (P^3I)
- Definition of high risk areas that require parallel or alternate approaches
- Logistics approach
- Requirements imposed by supporting organizations

The output of the strategy should be funding profiles by account and by year. These profiles would support a complete program from start of full scale development to deployment.

The Acquisition Strategy, by itself, is not sufficient for the conduct of a program. It must be supported by program plans which are the operating documents and generally quite detailed. These plans define the who, what, when and where of the program. The services have policies and detailed procedures for preparation of such plans. For example, AFSCP 800-3, "A Guide for Program Management," has been in existence for seven years.

The tough management job in DoD is to prevent the Acquisition Strategy from becoming the Program Plan. If the Acquisition Strategy can be held to truly significant issues, it will be a major management tool.

Conclusions. The Acquisition Strategy is a most important document and a clear understanding of what issues are to be addressed in the strategy is necessary. The details of program management should be placed in a Program Plan.

Principle #4: Program Managers/Program Management

The effectiveness of program managers and program management must be improved.

Background. The Panel conducted a survey of the Services and contractors regarding selection, training, career patterns and length of assignment of program managers. In addition, information from 52 military program managers was obtained regarding their views of program management. Among the subjects covered were manning levels, matrix management, colocation of personnel, and division of time between "outside" and "inside" activities. As a result of this information, the Panel concluded that the effectiveness of program managers and program management must be improved.

The survey indicated that the services have reasonably good career development programs, except for the Navy, where a formal program does not seem to exist. The Air Force and Navy occasionally use civilian program managers and judge their performance to be excellent. The Army has no plans for civilian program managers.

The survey also indicated that the average tour length for military program managers has improved, but is still less than an average of three years. By contrast, industry program managers have tours of up to 10 years with four to six years being quite common. Most companies have training programs of some sort, but the approach varies widely. On-the-job training seems most used. And both DoD and industry consider a program management assignment as career enhancing.

Colocation of functional directors with the program manager's office was found to be used by industry whenever possible. The lack of colocation is viewed as a serious problem by military program managers.

Three other related issues were discussed by the Panel. These issues dealt with program managers and related personnel requirements.

- Program Manager Continuity. DoDD 5000.23 - "System Acquisition Management Careers" - was issued in 1974 to establish policies for selection, training and career development of program managers. It is a good document, but it seems to have been largely ignored. However, it does have one provision that should be reconsidered. The directive states, "Changes of Program Managers, if necessary, should normally occur near major program milestones..." (underlining is in the original document).

  One of the major conclusions of this Task Force is that start-up of production is one of the most difficult periods of systems development. If there is one time that continuity of management is

critical, it is during this phase of early production and the related operational testing. The Management Panel suggests that this provision is not correct and should be deleted.

- o Program Office Responsible for One Program. Several of the briefings to the Panel indicated that the services are moving in the direction of assigning more than one significant program to a single program office. The reason given was usually that personnel shortages are forcing such actions. The contractor members of the panel noted that the services would be less than happy if the contractors took such a step. Managing a major program takes the full time (or more) of a manager. If the data received is correct, we strongly urge that any move in the direction of multi-programs per program office be carefully reviewed.

- o Line Management Control Over Personnel Functions. The Panel was briefed on the Civil Service experiment being conducted at the naval Weapons Center, China Lake, and at NOSC, San Diego. The thrust of the experiment is to provide local organizations greater line management control over personnel functions. Primarily, it provides local management flexibility in recruiting and pay scales, and links pay to performance. Salary offers to entry level scientists and engineers are flexible, and these organizations have been able to compete more effectively for new graduates. The experiment has been underway for several, years and the results are very encouraging. The Panel was informed that, because of the success to date, it is being considered for application in many other Service technical organizations. The Management Panel supports this initiative.

Conclusions. The following conclusions were drawn by the panel:

- o Tour lengths for military program managers appear too short.

- o Lack of colocation of program office and functional support personnel is a serious problem.

- o There is an increasing use of government civilian program managers, except in the Army.

- o The Civil Service experiment being conducted at several naval installations is very encouraging.

Principle #5: Funding Flexibility

In order to improve the management of programs, the Secretary of Defense urgently needs greater flexibility in movement of funds between and among accounts.

Background. Quite often toward the end of development, the Program Manager has inadequate RDT&E funds remaining, but he has production funds that he cannot effectively utilize because of program stretch-outs or a startup that was slower than planned. The Secretary of Defense currently has limited

authority ($750 million in FY 1982) to reprogram funds. The requirement for four Congressional committee approvals makes it unwieldy and time consuming. Approval of such transfer action may take from six to eight months.

Acquisition Improvement Program Initiative #15 addressed the need for greater funding flexibility. In the 1983 budget submittal, the OSD proposed that they be allowed to transfer funds between RDT&E and procurement accounts in a given fiscal year for an individual weapon system.

The House Appropriations Committee was less than enthusiastic about the request. Their committee report states:

> "Such a change would lessen the ability of the Congress to maintain oversight, and would add to the already serious problem of transitioning prematurely from development to production. The Committee is strongly opposed to the proposed revision. The Committee handles reprogramming requests expeditiously, and will continue to do so."

The Panel strongly supports OSD's efforts to obtain greater funding flexibility.

Conclusion. In order to improve the management of programs, the Secretary of Defense urgently needs greater flexibility in movement of funds between and among accounts. In spite of congressional opposition, efforts to secure greater flexibility should be continued.

ADDITIONAL OBSERVATIONS

Military Specifications

Background. One of the tasks assigned to the Panel concerned the adequacy of Mil-Specs and standards. The scope was expanded by the Panel to include:

- "Tailoring" to specific programs
- Are Mil-Specs an asset or a liability?
- How to keep Mil-Specs updated
- What could be used in lieu of mil specs?

The Panel reviewed the DSB study, "Report of the Task Force on Specifications and Standards," dated January 15, 1977. That Task Force concluded that specifications and standards should not and cannot be eliminated from the DoD procurement system. The Panel found nothing that would challenge that conclusion.

After submittal of the 1977 study, DoDD 4120.3 "Defense Standardization and Specifications Program," was revised to reflect many of the recommendations. In addition, a new DoDD 4120.21 was issued which provided the rules for

application and tailoring. The current version is dated November 3, 1980. The directive is reasonably clear, but implementation has been difficult. Tailoring is a tough job which requires experienced people. Quite often, in the press to issue an RFP, tailoring falls by the wayside. Contractors perceive that, if they propose tailoring, they will be considered non-responsive. This Panel believes that an adequate framework for tailoring exists but with little motiviation for implementation. Some management attention would help.

The Panel received a briefing on Mil-Prime. This is a program at AFSC's Aeronautical Systems Division which is developing specifications and standards stated in terms of operational needs. It has built-in tailoring since, in effect, the procuring agency is forced to fill in its own numbers. The briefing was encouraging, but this approach is not used throughout AFSC.

The Panel took a limited look at the problems of keeping specifications and standards up-to-date. Although each document is assigned to a specific organization for keeping it current, the update program is very much behind schedule. The two basic problems are: 1) lack of technical personnel for what is considered a low-priority job, and 2) no identified funding for the effort. The Panel believes that adequate funding for this effort would be a useful step. In addition, automating the process should be examined.

Conclusions. In summary, the specific conclusions of the Panel on the subject of military specifications are:

- Specifications and standards are necessary for the DoD procurement system.
- "Tailoring" is well defined but is not implemented with vigor.
- AFSC's Aeronautical System Division Mil-Prime approach appears to have value, but its application is very constrained. Consideration should be given to expanding the program.
- The update program for standards and specifications is seriously behind schedule, primarily because of no identified funding.

Data Requirements

Background. While examining the Specifications and Standards issue, the Panel received a briefing from the USAF Electronics System Division (ESD) on a study of ESD data requirements. The objective of the study was to assess the perceived problem that the government requires too much data of all types on acquisition contracts and to recommend appropriate actions. The Management Panel also requested industry views on data requirements.

The ESD study team concluded that the government did, in fact, ask for too much data in requests for proposals and contracts; however, it was impossible to quantify this conclusion. Direct costs for data ranged from an estimated

six percent to twenty percent of the contracts, and this does not include overhead costs, nor does it include the cost to the government of processing, reviewing and managing the data.

Industry responses to the Management Panel requests for information can be summarized as follows:

- The Cost/Schedule Control System (C/SCS) frequently is applied in a very inflexible way, requiring too much detail. The level of reporting should be raised to work breakdown structure (WBS) level 3, and the requirement for analysis should be limited to significant cost and schedule variances. The requirement for SARs should be waived when ample evidence exists that the company has a good C/SCS system.

- The amount of data required from contractors is probably excessive, but it is difficult to quantify. This appears to be a problem that must be worked out for each program. The problem can be minimized only by much cooperative effort on the part of both the customer and the contractor. In most cases, it appears that overall costs could be reduced by using the internal company reports and data rather than imposing a unique government requirement.

Conclusion. Tailoring of contract data requirements lists (CDRLs) is difficult, gets lip service, but little action. Other DoD organizations should review the ESD report for possible implementation.

Affordability

Background. Several versions of DoD Directive 5000.1 have stressed affordability. The most recent version (March 1982) stresses the relationship between the PPBS and DSARC process and states: "Approval to proceed into full-scale development or into production shall be dependent on DoD Component demonstration that resources are available or can be programmed to complete development, to produce efficiently and to operate and support the deployed system effectively. Funding availability shall be reaffirmed by the DoD Component before proceeding into production and deployment." Reference is then made to "specific facets of affordability," which are in DoDI 5000.2. Unfortunately, DoDI 5000.2 does not say anything specific. It appears that there is some confusion regarding the application of the concept of affordability.

While the inputs were far from exhaustive, the Panel concluded that there is not a consistent approach to affordability. The Panel also concluded that a new program which approaches the full scale development decision point should be judged against the total service program and the resource commitments made by previous decisions. If a "bow-wave" already exists there is little justification for a new program start unless some other previously approved program can be cancelled or reduced in scope (which certainly doesn't enhance stability). Until there is a realistic look at the implications of previous decisions, more programs will continue to enter FSED than can be afforded in later years. This is a very serious problem which seems to be recognized but is not being resolved.

Conclusion. The question of affordability deserves greater scrutiny at tne time that Full Scale Engineering Development is contemplated.

Cost Estimating and Program Change.

Background. The Management Panel feels that industry and government do, not only an acceptable, but normally, a very excellent job, in generating cost estimates for a program. However, as the program is executed, too many occasions arise where changes are made to the program which result in cost growth and the attendant loss of overall management credibility.

Conclusion. To minimize this situation, a great effort must be exerted at all levels in Defense to resist any changes to a program. When an acquisition strategy is agreed upon and the program is being executed, changes to the program must be exceptions to policy and not 'de-facto' policy.

RECOMMENDATIONS

Four major recommendations were derived from the "principles" previously discussed in this section:

1. Revise DoDD 5000.1 and DoDI 5000.2 to reflect the policy that "Transition to Production" is an integral part of the Full Scale Development process. Specifically, make the following changes:

   - o State that Milestone II is the commitment to produce and deploy.
   - o Require that at Milestone II, all necessary funds are programmed - RDT&E, Procurement, MILCON, etc.
   - o Define what should be included in the Acquistion Strategy and make it the "contract" between the Service and OSD.
   - o Limit the Acquisition Strategy to major issues. Require that details of a program be in Program Plans.
   - o Delete the "floating" Milestone II in the current DoDD 5000.1.

2. Review and revise as necessary, the regulations that inhibit or prohibit the application of procurement funds during Full Scale Engineering Development, or provide additional RDT&E funds for production preparation.

3. Continue pressing for funding flexibility - particularly for authority to transfer funds between RDT&E and procurement accounts.

4. Improve Program Management by:

   - o Defining career progressions for prospective Program Managers - both military and civilian.

- o Enforcing current criteria for selection of Program Managers.
- o Assigning additional civilians as Program Managers.
- o Stabilizing the tours of military Program Managers. Extend tours beyond the current practice of about 30 months.
- o Stopping the present trend of assigning several programs to one Program Manager.
- o Emphasizing the importance of colocation of functional directors with the program office.
- o Revising DoDD 5000.23 to delete the provision that encourages changing Program Managers at major program milestones.
- o Expanding the Civil Service experiment being conducted at Naval Weapons Center, China Lake and NOSC, San Diego.

The panel also provided the following recommendations based on the observations previously discussed:

1. Stimulate the Standards and Specifications update program by some management attention.
2. Clarify what is meant by "Affordability" and require closer scrutiny at Milestone II.
3. Make the Air Force Electronic Systems Division report on Data Requirements available to other organizations for possible implementation.
4. Consider expansion of the ASD Mil-Prime approach to other organizations.

APPENDIX A

TERMS OF REFERENCE

THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

RESEARCH AND
ENGINEERING

28 JUN. 1982

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Defense Science Board Task Force on the Transition of Weapon Systems from Development to Production

You are requested to organize and convene a Defense Science Board Task Force to review, evaluate and make recommendations concerning ways to improve and accelerate the transition of weapon systems into production.

Background - The past years have witnessed a dramatic and still accelerating interest in upgrading the reliability and maintainabiity of weapon systems, both in and programmed for ultimate delivery to the Services. The escalating cost of support, the unsatisfactory levels of effectiveness, and budget pressures to reduce the life cycle cost have been major stimuli underlying this renewed concern for delivering reliable and maintainable weapon systems. Yet, in spite of this professed interest and concern, tangible improvement in the reliability and maintainability of products reaching the field is slower than desirable. A major cause seems to center around the failure to make the proper transition from the design and development into manufacturing. It is to this element of the transition process that the Defense Science Board Task Force will direct its attention.

Tasks - Recent experience has shown that when proper disciplines and controls are applied throughout the conceptual and development process in the design and manufacturing activities, a quality product is delivered to the field. The Task Force will examine ways and methods to more clearly define and accelerate this process and will make recommendations as appropriate. These actions will be directed toward both the producing industry and the administering government. The following areas as a minimum will be examined as to their effects on the transition problem described previously:

1. Figures of merit for allocated design time - examples: man hours/thousand components.

2. Leading key predictors/indicators of potential design and manufacturing trouble.

3. Methods of displaying design confidence.

4. The design review process.

5. Test confidence vs. design confidence.

6. MIL-SPEC problems in speicifying environmental/operaticnal profiles.

7. Economics of design confidence and of manufacturing.

8. Minimum requirements for manufacturing capital investment.

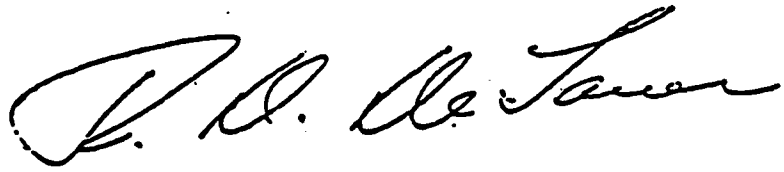
9. Shortening the test time by integrated testing.

10. Computer-aided-design requirements in the design review process.

11. Establishing part quality confidence in manufacturing.

12. Workmanship defects - cause and relation.

The findings and recommendations will be presented as an interim report by 1 December 1982, and in a final report by February 1983. This Task Force will be sponsored by the Deputy Under Secreary of Defense for Research and Engineering (Acquistion Management), Mr. William A. Long. Mr. Willis Willoughby has agreed to serve as chairman. Mr. John Smith will serve as the Executive Secretary and Col. Wayne Davis will be the DSB Secretariat representative on the Task Force.



APPENDIX B

TASK FORCE MEMBERSHIP LIST

Task Force on the Transition of Weapons Systems from Development to Production.

Willis J. Willoughby, Jr. Chairman	Deputy Chief of Naval Material for Reliability, Maintainability and Quality Assurance Headquarters, Naval Material Command
Dr. Fred P. Adler	Senior Vice President and Group President Electro Optical and Data Systems Group Hughes Aircraft Company
Dr. Dell K. Allen	Director, CAM Software Laboratory Brigham Young University
Robert A. Fuhrman	President Lockheed Missiles and Space Company
Robert G. Gibson	Private Consultant
J. Harry Goldie	Executive Vice President Department Management Boeing Aerospace Company
Ralph E. Hawes, Jr.	Vice President and General Manager Pomona Division General Dynamics
Burrell W. Hayes	Technical Director Naval Weapons Center
James R. Iverson	Senior Vice President of Government Marketing Gould, Inc.
Roy P. Jackson	Vice President and General Manager Aircraft Division Northrop Corporation
VADM Robert R. Monroe, USN	Director of Research, Development, Test and Evaluation, OP-98 Department of the Navy

BGEN Benjamin J. Pellegrini, USA	Commanding General Defense Systems Management College
Roland Peterson	President Guidance and Control Systems Division Litton
Dr. Joseph F. Shea	Senior Vice President, Engineering Raytheon Company
Harry B. Smith	Executive Vice President Defense and Electronics Systems Center Westinghouse Electric Corporation
LGEN James W. Stansberry, USAF	Commander Electronic Systems Division Air Force Systems Command
Eric E. Summer	Vice President Computer Technologies and Military Systems Bell Laboratories
Joseph C. Waldner	Vice President and General Manager McDonnell Douglas Aircraft Company
W. Pat Weber	Vice President and Group Manager Texas Instruments, Inc.
Warde F. Wheaton	Vice President and Group Executive Aerospace and Defense Group Honeywell Inc.

APPENDIX C

PANEL MEMBERSHIP LIST

DESIGN PANEL

Roy P. Jackson Chairman	Vice President and General Manager Aircraft Division Northrop Corporation
Thomas T. Burger	Director, F/A-18A Engineering and Logisitics Aircraft Division Northrop Corporation
Ralph E. Hawes, Jr.	Vice President and General Manager Pomona Division General Dynamics
Robert A. Fuhrman	President Lockheed Missiles and Space Company
William M. Leonard	Director of Productivity Pomona Division General Dynamics
L. David Montague	Vice President, Advanced Systems Lockheed Missiles and Space Company
William E. Montgomery	General Manager Space Division Westinghouse Electric Corporation
Stephen Pardee	Director, Design Process Development Center Bell Laboratories
Elliot Ring	Deputy Manager, Bedford Laboratories Missile Systems Division Raytheon Company

Dr. Joseph F. Shea	Senior Vice President, Engineering Raytheon Company
Harry B. Smith	Executive Vice President Defense and Electronics Systems Center Westinghouse Electric Corporation
Eric E. Sumner	Vice President, Computer Technologies and Military System Bell Laboratories

TEST PANEL

Joseph C. Waldner Chairman	Vice President and General Manager McDonnell Douglas Aircraft Company
Oliver F. Danielson	Chief, Technology Engineering McDonnell Douglas Aircraft Company
Ralph E. Hawes, Jr.	Vice President and General Manager Pomona Division General Dynamics
William M. Leonard	Director of Productivity Pomona Division General Dynamics
VADM Robert R. Monroe, USN	Director of RDT&E OP-98 Department of the Navy
Dr. Joseph F. Shea	Senior Vice President, Engineering Raytheon Company

PRODUCTION DISCIPLINES PANEL

Roland Peterson Chairman	President Guidance and Control Systems Division Litton

Dr. Fred P. Adler	Senior Vice President and Group President Electr Optical and Data Systems Group Hughes Aircraft Company
Robert A. Fuhrman	President Lockheed Missiles and Space Company
J. Harry Goldie	Executive Vice President Department Management Boeing Aerospace Company
Ralph E. Hawes, Jr.	Vice President and General Manager Pomona Division General Dynamics
James R. Iverson	Senior Vice President of Government Marketing Gould, Inc.
Roy P. Jackson	Vice President and General Manager Aircraft Division Northrop Corporation
Harry B. Smith	Executive Vice President Defense and Electronics Systems Center Westinghouse Electric Corporation
Joseph C. Waldner	Vice President and General Manager McDonnell Douglas Aircraft Company
Warde F. Wheaton	Vice President and Group Executive Aerospace and Defense Group Honeywell Inc.

FACILITIES AND INVESTMENT PANEL

LGEN James W. Stansberry, USAF Chairman	Commander Electronic Systems Division Air Force Systems Command
William L. Benfer	Manager, Contract Services Texas Instruments, Inc.
Ronald E. Brence	Manager, Contract Review Defense and Electronic Systems Center Westinghouse Electric Corporation

Richard J. Boyle	Vice President and General Manager Defense Systems Division Honeywell Inc.
Elmer Carmen	Director, Programs-Business Management Ocean Systems Division Gould, Inc.
Frederick J. Michel	Director for Manufacturing Technology Headquarters, U.S. Army Materiel Development and Readiness Command
John A. Orphanos	Director of Manufacturing Headquarters, Electronic Systems Division Air Force Systems Command
Steven W. Rowen	Director, Government Contracts Raytheon Company
RADM Joseph S. Sansone, Jr., USN	Deputy Chief of Naval Material for Contracts and Business Management Headquarters, Naval Material Command
CAPT. James R. Seeley, USN	Director, Program Assessment Deputy Chief of Naval Material for Reliability, Maintainability and Quality Assurance Headquarters, Naval Material Command
COL. John D. Slinkard, USAF	Deputy for Contracting Headquarters, Electronic Systems Division Air Force Systems Command
Harry B. Smith	Executive Vice President Defense and Electronics Systems Center Westinghouse Electric Corporation
Thomas G. Weyenberg	Corporate Director Government Contract Administration Gould, Inc.

MANAGEMENT PANEL

Robert A. Fuhrman Chairman	President Lockheed Missiles and Space Company
CAPT William A. Finn, USN	Assistant Deputy Chief of Naval Material for Reliability, Maintainability and Quality Assurance Headquarters, Naval Material Command
Robert G. Gibson	Consultant Defense Science Board
J. Harry Goldie	Executive Vice President Department Management Boeing Aerospace Company
Burrell W. Hays	Technical Director Naval Weapons Center
William W. McDowell (for Roy P. Jackson)	Director, Technical Operations Tiger Shark Program Northrop Corporation
VADM Robert R. Monroe, USN	Director of RDT&E OP-98 Department of the Navy
BGEN Benjamin J. Pellegrini, USA	Commanding General Defense Systems Management College
COL. T. Sanford, USAF (for LGEN James W. Stansberry)	Deputy Program Director, WIS Program Office Electronic Systems Division Air Force Systems Command
Warde F. Wheaton	Vice President and Group Executive Aerospace and Defense Group Honeywell Inc.

APPENDIX D

RECOMMENDATIONS FOR CONTINUED OSD/DSB ACTION

The initial intent of the study was to focus solely on principles and techniques that were consistent with current DoD policy and procedures. This was done in most cases and the results of this effort are reflected in the Transition Document (Appendix D). However, some of the findings and conclusions from the study point out the need for considering certain revisions to established DoD policies, government regulations and congressional legislation. Other results from the study indicate the need for specific and separate initiatives within DoD to either emphasize established policies and programs or to sponsor follow-on study tasks and/or implementing action. A summary of these recommended actions is provided in this appendix together with a page reference to the the applicable section of the Task Force Report for additional details.

RECOMMENDED ACTION	REPORT REFERENCE
Service T&E Policy should be amended to encourage agreements between contractors and the military services to jointly participate in DT&E during FSED.	Page 18 - Military Participation in FSED Tests
Service policy concerning on-site engineering teams should be added to DoDD 5000.40 and MIC-STD 785B.	Page 19 - Field Operational Performance Feedback during the Early Manufacturing Process
Qualified Products List (QPL) program should be re-established by the government.	Page 23 - Establishing Parts Quality Confidence in Manufacturing
Uniform set of screening requirements should be completed by Institute of Environmental Sciences and put into use.	Page 23 - Establishing Parts Quality Confidence in Manufacturing

Services should clarify policy on: - Government control of technical data package during early production - Timing of multiple sourcing during early production - Local Material Review Board authority - Constructive Government attitude during early production phase - Organic depot support versus contractor support - Product Improvement Warranties	Page 25 - Cooperative Participation by government and industry; and Page 26 - Depot Organic Support
Corrective action system commitment and guidance should be provided by DoD and communicated to contracting organizations.	Page 27 - Corrective Action Systems
Risk Management techniques should be given wider publicity throughout government and industry.	Page 29 - Risk Management
Industrial modernization incentives program should continue to be actively supported by DoD.	Page 32 - Industrial Modernization Incentives
Production planning early in the acquisition process should receive strong emphasis by DoD.	Page 33 - System Acquisition Procedures and; Page 24 - Recipe for Entering Production
Totally integrated CAD/CAM systems should be encouraged and industry should be motivated by DoD to adopt and use these systems.	Page 34 - Productivity and Design Manufacturing Interaction
Data Base Technology for CAD/CAM systems should be developed under leadership provided by DoD and the National Bureau of Standards.	Page 34 - Data Base Technology
Long range strategic planning for industrial facilities should be developed by DoD and industry should be encouraged to do the same.	Page 35 - Corporate Strategic Planning
CAD/CAM training should be encouraged by DoD and emphasized and implemented throughout industry.	Page 35 - Human Resources

Action should be taken on the following issues: - Recovery of interest expense as a cost - Recovery of CAD/CAM expense - Independent research and development - Multiyear procurement - Competition - Facilities capital employed (Underabsorption) - Foreign Military Sales (DAR restrictive requirements) - Technology transfer - Manufacturing research - Productivity payback	Page 36 - Position Papers
DoD policy on transition should be modified to view the transition as a phase rather than a single milestone.	Page 40 - Principle #1: "Transition Phase" versus Production Milestone (and Recommendations, Page 51) (Note: See also, Page 17, Initial Operational Test and Evaluation).
DoD policy on Milestone II decision should state that it represents a commitment to produce and deploy the system.	Page 42 - Principle #2: Commitment to Produce and Deploy (and Recommendations, Page 51)
Acquisition Strategy should be clarified and receive additional emphasis by DoD.	Page 44 - Principle #3: Acquisition Strategy (and Recommendations, Page 51)
Program Management must be improved by actions such as those recommended in the Panel report: - Define career progression for program manager - Enforce current critera for program manager selection - Assign additional civilians to program management positions - Stablize tour of military program managers - Stop trend to multi-program, program offices - Emphasize importance of colocation of functional directors and program manager - Change policy that encourages shift in program manager during transition (DoDD 5000.23)	Page 46 - Principle #4: Program Managers/Program Management (and Recommendations, Page 51)

- Expand civil service experiement initiated at Naval Weapons Center, China Lake and NOSC, San Diego

Funding flexibility should continue to be pursued as a very tangible and relevant way to improve the transition process.

Page 47 - Principle #5: Funding Flexibility (and Recommendations, Page 51)